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*Allen Hardy*  
April 5, 1950

INTERNATIONAL GEOLOGICAL CONGRESS

REPORT OF THE EIGHTEENTH SESSION  
GREAT BRITAIN 1948



PART I

GENERAL PROCEEDINGS

LONDON  
1950

UNIVERSITY OF ILLINOIS AT  
CHICAGO CIRCLE  
801 SO. MORGAN  
CHICAGO, IL. 60607



INTERNATIONAL GEOLOGICAL CONGRESS //

REPORT OF THE EIGHTEENTH SESSION  
GREAT BRITAIN 1948

*General Editor: A. J. Butler*

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PART I

GENERAL PROCEEDINGS

*Edited by*

A. J. BUTLER

LONDON  
1950

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## PREFACE

**A**S a preface to this Report of the Eighteenth Session of the International Geological Congress I wish simply to express the warm and enduring gratitude of British geologists to all delegates and members from abroad who visited us in 1948.

The organization of the Eighteenth Session was long interrupted by the Second World War and was completed in its troubled aftermath. We here in Great Britain could offer far less to our colleagues from other countries than was our wish. Yet they came here in great number and were generous in their praise.

We are indeed proud to have received this great concourse of scientists of the earth. We are proud to have forged a link in time between those who met in Moscow in 1937 and those who will meet in Algiers in 1952; and a link in space between our fellow workers throughout the world.

This printed Report, although it is large, is still necessarily less lavish in size and form and illustration than is warranted by the number and quality of the scientific contributions which were presented at the Session. We trust that it may nevertheless prove acceptable as a lasting record of a great occasion in these British Islands.

H. H. READ,  
*President of the Eighteenth Session.*

# HISTORY OF THE CONGRESS

## I. FOUNDING COMMITTEE (1875)

PRESIDENT: James Hall (United States).

SECRETARY: T. Sterry Hunt (Canada).

MEMBERS: William B. Rogers, J. W. Dawson, J. S. Newberry, C. H. Hitchcock, R. Pumpelly, J. P. Lesley (United States and Canada); T. H. Huxley (Great Britain); Otto Torrell (Sweden); E. H. de Baumhauer (Netherlands).

## II. PRESIDENTS

E. Herbert, 1878	J. G. Aguilera, 1906
G. Capellini, 1881	G. de Geer, 1910
E. Beyrich, 1885	F. D. Adams, 1913
J. Prestwich, 1888	J. Lebacz, 1922
J. S. Newberry, 1891	C. Rubio, 1926
E. Renevier, 1894	A. W. Rogers, 1929
A. Karpinsky, 1897	W. Lindgren, 1933
A. Gaudry, 1900	I. M. Goubkin, 1937
E. Tietze, 1903	H. H. Read, 1948

## III. SUMMARY OF SESSIONS

No.	Year	Country	Place	Countries represented	Members*		Delegates
					Total	Present	
1	1878	France .....	Paris .....	23	310		7
2	1881	Italy .....	Bologna.....	22	420	224	15
3	1885	Germany .....	Berlin.....	22	445	262	13
4	1888	Great Britain .....	London.....	25	830	422	37
5	1891	United States .....	Washington ...	26	546	251	30
6	1894	Switzerland .....	Zürich .....	20	401	273	14
7	1897	Russia .....	St. Petersburg..	27	1,037	704	121
8	1900	France .....	Paris .....	30	1,016	461	61
9	1903	Austria .....	Vienna .....	31	664	393	42
10	1906	Mexico .....	Mexico .....	34	707	321	52
11	1910	Sweden .....	Stockholm ....	36	879	625	175
12	1913	Canada .....	Toronto.....	49	981	467	362
13	1922	Belgium.....	Brussels.....	38	518	321	123
14	1926	Spain.....	Madrid .....	52	1,123	722	277
15	1929	Union of South Africa	Pretoria.....	50	575	298	117
16	1933	United States .....	Washington ...	54	1,182	665	141
17	1937	U.S.S.R. ....	Moscow .....	50	2,362	949	157
18	1948	Great Britain .....	London.....	84	1,778	1,276	472

\* Including delegates.

Relatives who accompanied Members attending the Eighteenth Session were allowed the facilities of Membership without separate registration and fee. The total attendance of Members and accompanying relatives was over 1600.



# STATUTS DU CONGRES GEOLOGIQUE INTERNATIONAL

adoptés en Séance Générale du 19 Aout 1922  
et complétés par l'Assemblée Générale du 29 Juillet 1937

1. **BUT.** Le but du Congrès Géologique International est de contribuer au développement des recherches qui se rattachent à l'étude de la Terre, considérée aux points de vue théorique et pratique.
2. **SESSIONS.** Les sessions du Congrès sont convoquées tous les trois ou quatre ans et durent environ une semaine.  
Au cours de chacune d'entre elles, les invitations reçues pour la session suivante sont examinées et une décision est prise à leur égard par l'Assemblée générale.
3. **EXCURSIONS.** Les excursions constituent une partie importante des sessions du Congrès.  
Toute facilité est donnée aux membres pour l'étude de la constitution géologique et des ressources minérales du pays où a lieu la session.  
Organisées avec un minimum de dépenses, elles sont effectuées sous la direction de guides compétents et facilitées par la publication de livrets-guides donnant une esquisse géologique aussi complète que possible des pays visités.
4. **PUBLICATIONS.** Le compte rendu de la session est publié le plus tôt possible après la clôture de celle-ci.  
Il renferme les communications faites au cours de la session, les discussions auxquelles celles-ci ont donné lieu, et enfin un rapport général sur les finances et les autres manifestations de l'activité du Congrès.
5. **COMMISSIONS PERMANENTES.** Des commissions permanentes sont organisées pour l'étude de questions géologiques d'ordre général, impliquant une collaboration internationale.
6. **PRIX.** Le Congrès peut décerner des prix pour récompenser les travaux de haut intérêt se rapportant aux divers domaines de la géologie.
7. **COMITE D'ORGANISATION.** Un Comité d'organisation est élu par le pays où doit avoir lieu la session suivante, dès que ce pays a été avisé de l'acceptation de son invitation.  
L'adresse postale de ce Comité est indiquée sans retard aux membres du Conseil de la session qui vient de prendre fin.  
Toutes les communications concernant la session suivante doivent être adressées au Comité chargé de l'organisation de cette session, de son programme, de ses excursions et de ses publications.  
Ce Comité invite les Gouvernements étrangers, les Académies, les Services et Sociétés Géologiques et les Universités.  
Il reçoit les rapports faits dans l'intervalle des sessions par les Commissions permanentes.
8. **MEMBRES DU CONGRES.** Aucun titre professionnel n'est exigé à l'appui des demandes d'inscription. Néanmoins, les excursions organisées avant et après la session seront plus spécialement réservées aux membres du Congrès qui sont géologues, géographes, ingénieurs des mines et aux autres personnes qui se livrent à l'étude ou à l'application d'une branche quelconque de la géologie.
9. **CONSEIL.** Pendant les sessions, le Congrès est administré par un Conseil comprenant:  
(1) Des représentants du Comité d'organisation, dont le nombre ne doit pas être supérieur à six et qui seront désignés sur présentation faite par ce Comité.



## PART I : GENERAL PROCEEDINGS

- (2) Les délégués des gouvernements et des académies, les présidents ou directeurs des services géologiques, des sociétés géologiques et des institutions universitaires, à qui une invitation à été faite. En cas d'absence, ils peuvent être représentés par un délégué.
- (3) Les membres du Congrès que le Conseil, constitué ainsi qu'il est dit aux 1 et 2, juge à propos d'appeler dans son sein.

Le Conseil fixe les ordres du jour et discute toute question devant être soumise à l'Assemblée générale.

10. **ASSEMBLEE GENERALE.** L'Assemblée générale est formée par l'ensemble des membres de la session. Elle prend ses résolutions à la majorité des membres présents.
11. **BUREAU.** Le Bureau est constitué à la première Assemblée générale. Le Comité d'organisation fait des propositions pour le choix du président et du secrétaire général; le Conseil, pour les vice-présidents.

Le Bureau conserve ses pouvoirs jusqu'à la nomination du Comité d'organisation de la session suivante. Il lui transmet les archives du Congrès. Il assure la publication du compte rendu de la session et le règlement de toutes les affaires engagées.

La première séance de chaque session est ouverte par le président de la session précédente, ou son délégué, qui quitte le fauteuil dès que son successeur est élu.

12. **MODIFICATION AUX STATUTS.** Toute proposition de modification aux statuts du Congrès doit être soumise par écrit au Comité d'organisation, neuf mois au moins avant l'ouverture d'une session. Le Comité en notifie le texte aux institutions représentées à la session précédente.

Pour être adoptée, toute modification des statuts doit recueillir les suffrages des deux tiers des membres du Conseil et être ratifiée par les deux tiers des membres présents à l'Assemblée générale à laquelle la modification est soumise.

13. Toute communication remise à une session pour être publiée devient la propriété du Bureau de la session, et avant cette publication, elle ne peut être reproduite ailleurs sans l'autorisation écrite du secrétaire général de la session.



# INTERNATIONAL GEOLOGICAL CONGRESS

## Statutes

(TRANSLATION FROM THE FRENCH ORIGINAL)

1. **AIM.** The purpose of the International Geological Congress is to contribute to the advancement of investigations relating to the study of the Earth, considered from theoretical and practical points of view.
2. **SESSIONS.** The sessions of the Congress are called every three or four years, to continue for about one week.

At each session, invitations for the next session are considered and decisions concerning them are taken at a General Meeting.
3. **EXCURSIONS.** The excursions form an important feature of each session.

Every possible facility is given to members to study the geological structure and the mineral resources of the country where the session is held.

Organized with minimum expense, they are carried out under the direction of competent guides and made easy by the publication of guide books giving a geological sketch, as complete as possible, of the regions visited.
4. **PUBLICATIONS.** A "compte rendu" of the session is published as soon as possible after the closing of the session. It contains the papers read at the meetings of the session, the discussions arising therefrom, and lastly a general report on matters of finance and other spheres of action of the Congress.
5. **STANDING COMMITTEES.** Committees are organized for the study of general geological matters requiring international collaboration.
6. **PRIZES.** The Congress may award prizes for works of great interest in the various fields of geology.
7. **ORGANIZING COMMITTEE.** An Organizing Committee is appointed by the country in which the next session is to be held, as soon as this country is informed of the acceptance of its invitation.

The postal address of the Committee is notified promptly to the Members of the Council of the preceding session.

All communications concerning the next session must be addressed to the Committee appointed to organize that session, its programme, excursions and publications.

This Committee invites foreign Governments, Academies, Geological Surveys and Societies, and Universities.

It receives reports prepared between sessions by the standing Committees.
8. **MEMBERSHIP.** No professional title is required to support a request to register. Nevertheless the excursions organized before and after the session will be more especially reserved for the Members of the Congress who are Geologists, Geographers and Mining Engineers, and for other persons who devote themselves to the study or practice of some branch of Geology.
9. **COUNCIL.** The Congress is conducted during its sessions by a Council composed of:—
  - (1) Members of the Organizing Committee for that session, whose number shall not exceed six and who will be appointed on the recommendation of this Committee;

## PART I: GENERAL PROCEEDINGS

- (2) Delegates of the Governments and Academies, Presidents or Directors of Geological Surveys, Societies and Universities, to whom an invitation has been sent. If unable to attend they may be represented by a delegate;
- (3) Members of the Congress whom the Council, constituted as stated in (1) and (2), thinks fit to co-opt.

The Council draws up the agenda and discusses any questions to be submitted to the General Meeting.

10. GENERAL MEETING. The General Meeting is constituted by all the Members of the Session. Resolutions are adopted by a majority of Members present.

11. BUREAU. The "Bureau" is constituted at the first General Meeting of the session. The Organizing Committee makes proposals for the choice of the President and the General Secretary; the Council for the Vice-Presidents.

The Bureau holds office until the nomination of the Organizing Committee for the following session, to whom it transmits the archives. It has to arrange for the publication of the "Compte rendu" and the settlement of all engagements entered into.

The first meeting of each session is opened by the President of the previous session, or by his representative, who resigns the Chair as soon as his successor is elected.

12. MODIFICATIONS TO STATUTES. Any proposal to modify the statutes of the Congress must be submitted in writing to the Organizing Committee at least nine months before the opening of the session. The Committee transmits the text of these proposed modifications to the institutions represented at the previous session.

Any modification of the Statutes must, in order to be adopted, receive votes of two-thirds of the Members of the Council and must be ratified by two-thirds of the Members of the Congress present at the General Assembly at which the modification is made.

13. All papers turned over to the Session for publication become the property of the Bureau and until published may not be printed elsewhere without the written permission of the General Secretary of the Session.

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Adopted at the General Meeting of the 13th Session in Brussels, August 19th, 1922, and amended at the 17th Session in Moscow, July 29th, 1937.



## HISTORY OF THE ORGANIZATION OF THE EIGHTEENTH SESSION

**1937-1939.** With the approval of His Majesty's Government, the Geological Society of London presented to the Congress, at the Seventeenth Session in Moscow in 1937, an invitation to hold the Eighteenth Session in London in 1940. This invitation was accepted, and preparations in Great Britain began immediately. The office and headquarters of the Session were established in the building of the Geological Survey and Museum in South Kensington.

An appeal for financial support met with generous response from many British scientific societies and institutions, industrial organizations and individual donors. The preparation and organization of the Session were placed in the charge of a widely representative General Organizing Committee, and executive authority was vested in a smaller Executive Committee. Sir William Bragg, O.M., President of the Royal Society, accepted the office of Honorary President of the General Organizing Committee. Dr. W. F. P. McLintock and Professor W. B. R. King were appointed as joint General Secretaries of the General Organizing and Executive Committees, and Mr. F. N. Ashcroft as Treasurer. In July, 1938, a First Circular outlining the plans for the Session was distributed to individual geologists and to geological institutions throughout the world.

Later in 1938 Sir Thomas Holland, then Principal and Vice-Chancellor of the University of Edinburgh, was elected President of the General Organizing Committee and President-Designate of the Eighteenth Session. Under his Chairmanship the Officers and Executive Committee proceeded to plan a detailed programme for the Session, taking account of comments and suggestions received in response to the First Circular; and at the same time a detailed programme of long excursions was prepared by an Excursions Committee under the Chairmanship of Dr. E. B. Bailey (now Sir Edward Bailey). In December, 1938, invitations to appoint official Delegates to the Eighteenth Session were transmitted to Governments, geological societies, universities and other interested institutions throughout the world. In June, 1939, a Second Circular describing the detailed plans for the meetings and excursions was distributed.

On the outbreak of the Second World War in September, 1939, it was clear that organization must be suspended. The Session was formally postponed *sine die* in November, 1939, by resolution of the Council of the Geological Society, following a recommendation from the Executive Committee.

**1945-1948.** Near the end of 1945 the Council of the Geological Society and the Executive Committee decided that it was practicable to hold the Eighteenth Session in 1948. The support of the British Government was reaffirmed and preparations were renewed in 1946.

During the wartime interval the General Organizing Committee had lost by death its Honorary President, Sir William Bragg, O.M., and several of its members. The General Secretaries, Dr. W. F. P. McLintock and Professor W. B. R. King, and the Chairman of the Excursions Committee, Sir Edward Bailey, found that they were unable to continue in office after 1945 because of other duties and engagements. A number of new appointments to the General Organizing Committee were therefore made; Mr. A. J. Butler and Professor L. Hawkes were appointed as General Secretaries, and Mr. T. Eastwood as Chairman of the Excursions Committee; and the membership of the Executive Committee was revised.

In January, 1947, the General Organizing Committee approved the selection of the period August 25th to September 1st, 1948, as the precise time for the Eighteenth Session in London; and some 27,000 copies of a Third Circular, superseding the First and Second Circulars, and describing revised plans for the meetings and excursions, were distributed throughout the world in March, 1947. At the same time invitations to Governments, societies, universities and other institutions were renewed.

## PART I: GENERAL PROCEEDINGS

In May, 1947, the Committees suffered a grievous loss in the death of the President-Designate, Sir Thomas Holland. Professor H. H. Read, F.R.S., President of the Geological Society and a Vice-President of the General Organizing Committee, was appointed to succeed Sir Thomas as President of the General Organizing Committee and President-Designate of the Session.

Later in 1947 Sir John Anderson, P.C., G.C.B., F.R.S., M.P., accepted the office of Honorary President of the General Organizing Committee.

In response to the Third Circular nearly 2,000 persons (about 1,500 prospective Members, accompanied by about 500 relatives) signified that they hoped to attend the Session, and indicated the subjects for discussion and the excursions in which they were particularly interested. As before the war, the Executive Committee took account of these replies in deciding the final details of the technical and long excursion programme, which were issued in a Fourth Circular in November, 1947. Finally, a Fifth Circular, including supplementary information concerning the arrangements for the Session and also a programme of short excursions and visits centred on London, was distributed in March, 1948.

The period January to July, 1948, was one of considerable anxiety for the Officers and Executive Committee. Many countries found it necessary to increase restrictions upon the issue of currency for travel abroad; and other adverse international economic and political conditions also became evident. The relative scarcity of accommodation on some passenger shipping routes to Great Britain was another cause of difficulty. The Officers and Committees did all that they could to negotiate special arrangements for Congress members in order to overcome these several hindrances to attendance at the Session, with substantial success. A record number of members and relatives was in fact present at the Session.

The following lists show the membership of the General Organizing, Executive and Excursions Committees during the final stages of organization in 1948.



# MEMBERSHIP OF COMMITTEES

(AS CONSTITUTED IN 1948)

## GENERAL ORGANIZING COMMITTEE

### HONORARY PRESIDENT

The Rt. Honourable Sir John Anderson, P.C., G.C.B., G.C.S.I., G.C.I.E., LL.D., F.R.S., M.P.

### PRESIDENT

Professor H. H. Read, F.R.S., President of the Geological Society of London

### HONORARY MEMBERS

The Rt. Hon. The Lord President of His Majesty's Most Honourable Privy Council  
The Lord Lieutenant of the County of London  
The Rt. Hon. The Lord Mayor of London  
The Rt. Hon. The Chairman of the London County Council  
The Chancellor of the University of Cambridge  
The Chancellor of the University of London  
The Chancellor of the University of Oxford  
The Chancellor of the University of St. Andrews  
The President of the Royal Society  
The President of the Royal Society of Edinburgh  
The Director-General of the Ordnance Survey  
The Hydrographer of the Navy  
The Director of the British Museum (Natural History)  
The Director of the Royal Botanic Gardens, Kew  
The Rt. Hon. Viscount Bearsted, Chairman of the Shell Transport and Trading Co., Ltd.  
Sir Edward Bailey, F.R.S.  
Sir William Fraser, C.B.E., President of the Anglo-Iranian Oil Company, Ltd.  
Sir Kenneth Harper, Chairman of the Burmah Oil Company, Ltd.

### OFFICERS

*Vice-President* ... Dr. W. F. P. McLintock, Director of the Geological Survey of Great Britain  
*General Secretaries* ... Mr. A. J. Butler, Professor L. Hawkes  
*Treasurer* ... Mr. F. N. Ashcroft

### EX-OFFICIO MEMBERS

The President of the Society of Antiquaries  
The President of the Chemical Society  
The President of the Linnean Society of London  
The President of the Zoological Society of London  
The President of the Royal Geographical Society  
The President of the Institution of Civil Engineers  
The President of the Institution of Mining Engineers

## PART I : GENERAL PROCEEDINGS

The President of the Institution of Mining and Metallurgy  
The President of the Institution of Structural Engineers  
The President of the Institute of Petroleum  
The President of the British Association  
The President of the Geologists' Association  
The President of the Mineralogical Society of Great Britain and Ireland  
The President of the Palaeontographical Society  
The President of the Royal Anthropological Institute  
The President of the Council for the Preservation of Rural England  
The President of the Royal Geological Society of Cornwall  
The President of the Edinburgh Geological Society  
The President of the Geological Society of Glasgow  
The President of the Liverpool Geological Society  
The President of the Manchester Geological and Mining Society  
The President of the Manchester Geological Association  
The President of the Yorkshire Geological Society

## COMMITTEE MEMBERS

Dr. D. A. Allen	Mr. T. Eastwood
Dr. W. J. Arkell	Mr. F. H. Edmunds
Dr. A. Chester Beatty	Mr. W. N. Edwards
Mr. W. S. Bisat	Dr. G. L. Elles (Miss)
Mr. M. Black	Mr. P. Evans
Mr. C. W. Boise	Mr. V. A. Eyles
Professor P. G. H. Boswell	Professor W. G. Fearnside
Professor W. S. Boulton	Sir Lewis L. Fermor
Dr. A. Brammall	Professor E. J. Garwood
Mr. C. E. N. Bromehead	Professor T. N. George
Mr. E. E. S. Brown	Professor W. T. Gordon
Dr. A. J. Bull	Dr. A. F. Hallimond
Dr. O. M. B. Bulman	Dr. J. V. Harrison
Dr. R. Campbell	Sir Harold Hartley
Mr. R. G. Carruthers	Professor H. L. Hawkins
Professor J. K. Charlesworth	Professor H. G. A. Hickling
Professor A. H. Cox	Professor S. E. Hollingworth
Dr. L. R. Cox	Professor A. Holmes
Dr. C. F. Davidson	Mr. J. Allen Howe
Dr. A. Morley Davies	Dr. R. G. S. Hudson
Mr. G. M. Davies	Professor V. C. Illing
Mr. H. Dewey	Professor D. E. Innes
Mr. T. Dewhurst	Dr. H. Jeffreys
Mr. H. G. Dines	Mr. H. J. Joel
Mr. C. H. Dinham	Miss M. S. Johnston
Dr. F. Dixey	Professor O. T. Jones
Mr. E. E. L. Dixon	Dr. W. R. Jones
Mr. I. S. Double	Professor W. Q. Kennedy
Professor J. A. Douglas	Professor W. B. R. King
Dr. K. C. Dunham	Dr. W. D. Lang
Mr. W. Dunkels	Dr. G. M. Lees



## MEMBERSHIP OF COMMITTEES

Mr. B. Lightfoot	Dr. G. F. Herbert Smith
Dr. A. G. MacGregor	Dr. Stanley Smith
Dr. Murray Macgregor	Dr. W. Campbell Smith
Dr. W. F. P. McLintock	Dr. L. F. Spath
Professor C. E. Marshall	Dr. L. J. Spencer
Dr. G. H. Mitchell	Professor L. D. Stamp
Dr. H. M. Muir-Wood (Miss)	Dr. C. J. Stubblefield
Mr. T. C. Nicholas	Professor H. H. Swinnerton
Dr. F. J. North	Dr. W. E. Swinton
Dr. W. L. F. Nuttall	Dr. H. Dighton Thomas
Dr. K. P. Oakley	Professor C. E. Tilley
Sir Ernest Oppenheimer	Dr. S. I. Tomkeieff
Mr. Louis Oppenheimer	Dr. C. T. Trechmann
Mr. Otto Oppenheimer	Dr. F. M. Trotter
Dr. J. Phemister	Dr. A. E. Trueman
Professor T. C. Phemister	Dr. G. W. Tyrrell
Professor F. Coles Phillips	Professor L. R. Wager
Dr. R. W. Pocock	Dr. F. S. Wallis
Dr. J. Pringle	Professor D. M. S. Watson
Professor W. J. Pugh	Mr. T. H. Whitehead
Dr. R. H. Rastall	Professor W. F. Whittard
Sir Richard A. S. Redmayne	Mr. W. H. Wilcockson
Dr. J. E. Richey	Dr. David Williams
Dr. T. Robertson	Professor L. J. Wills
Dr. K. S. Sandford	Dr. G. V. Wilson
Mr. J. B. Scrivenor	Professor A. Wood
Professor F. W. Shotton	Professor S. W. Wooldridge
Dr. J. B. Simpson	

## EXECUTIVE COMMITTEE

Mr. E. E. S. Brown	Dr. G. M. Lees
Dr. A. J. Bull	Dr. W. F. P. McLintock
Mr. C. H. Dinham	Dr. G. H. Mitchell
Professor J. A. Douglas	Dr. K. P. Oakley
Dr. K. C. Dunham	Dr. J. Phemister
Mr. T. Eastwood	Professor W. J. Pugh
Mr. W. N. Edwards	Dr. K. S. Sandford
Mr. P. Evans	Dr. W. Campbell Smith
Professor W. G. Fearnside	Dr. C. J. Stubblefield
Professor W. T. Gordon	Professor C. E. Tilley
Professor H. L. Hawkins	Dr. A. E. Trueman
Mr. J. Allen Howe	Professor D. M. S. Watson
Professor V. C. Illing	Mr. T. H. Whitehead •
Professor O. T. Jones	Dr. D. Williams
Professor W. B. R. King	Professor A. Wood

## PART I: GENERAL PROCEEDINGS

### PROGRAMME SUB-COMMITTEE

<i>Chairman</i>	...	Professor H. H. Read
<i>Secretaries</i>	...	Mr. A. J. Butler
		Professor L. Hawkes
Mr. F. N. Ashcroft		Dr. G. H. Mitchell
Dr. K. C. Dunham		Dr. C. J. Stubblefield
		Dr. D. Williams

### EXCURSIONS COMMITTEE

<i>Chairman</i>	...	Mr. T. Eastwood
<i>Secretaries</i>	...	Mr. A. J. Butler
		Dr. G. H. Mitchell
		Professor A. Wood
Mr. F. N. Ashcroft		Professor S. E. Hollingworth
Dr. W. J. Arkell		Professor O. T. Jones
Mr. E. E. S. Brown		Professor W. B. R. King
Professor J. K. Charlesworth		Dr. G. M. Lees
Mr. F. H. Edmunds		Professor H. H. Read
Professor W. G. Fearnside		Mr. T. H. Whitehead
Dr. G. W. Himus		

and

*ex officio*, all Leaders and Secretaries of long excursions

### DAY AND HALF-DAY EXCURSIONS SUB-COMMITTEE

Mr. E. E. S. Brown	Dr. G. W. Himus
Mr. F. H. Edmunds	Dr. G. H. Mitchell

### SECRETARIAT: OTHER HONORARY OFFICERS

<i>Deputy Treasurer</i>	...	Mr. C. H. Dinham
<i>Assistant Secretaries</i>		
<i>Publications</i>	...	Miss E. M. Guppy
<i>Excursions</i>	...	Mr. G. Bisson
		Miss M. O. Morris
<i>Registry and Meetings</i>	...	Mr. W. Bullerwell
		Mr. W. S. Pitcher
		Mr. P. A. Sabine

### PROFESSIONAL SECRETARIAT

<i>Assistant Secretary</i>	...	Miss B. M. Richardson
<i>Secretarial Staff</i>	...	Mrs. M. Russell
		Miss P. Ritson



## REGISTRATION AND ACCOMMODATION FOR MEETINGS AT THE EIGHTEENTH SESSION

THE Headquarters, Offices and Registry of the Session were situated in the building of the Geological Survey and Museum, South Kensington, London, S.W.7. The Third (Reserve and Study) Gallery of the Museum was furnished as a Members' Lounge with seating accommodation for 500 persons. Writing rooms, telephones and accommodation for small committee and commission meetings were also provided in this gallery. The Registry was installed in the Museum basement, and the adjoining courtyard was used as the Coach Excursion Station.

A personal wallet was made ready, before the Registry opened, for each member who had indicated his intention of attending the Session. Each wallet contained a complete set of the following articles and papers:—

A Membership Badge, bearing the member's name.

A Membership Card, bearing the member's name. (The cards of official Delegates were specially endorsed.)

A Programme of the Session, including the time and place of all meetings and functions, a map of meeting places, and other information.

A Provisional List of Registrants.

A Volume of Titles and Abstracts, containing the abstracts of all papers offered for presentation at the Session.

A Programme of Day and Half-Day (B) Excursions.

A Biography, *William Smith and the Birth of Stratigraphy*, by Dr. L. R. Cox.

A descriptive handbook, *The Geology of Eastern Ireland*, by the Directors of Excursion C.10.

An Index Map to the areas described in the 18 Geological Survey and Museum Handbooks on British Regional Geology.

In addition the following were appropriately distributed in the personal wallets:—

A Relative's Badge for each relative accompanying a Member, bearing the relative's name.

A Relative's Card, for each accompanying relative, bearing his or her name.

Tickets for long excursions, bearing the member's or relative's name; together with railway tickets wherever necessary.

A special guide to the route of each long excursion on which the member had booked places.

A "Data Card," for each overseas member, containing tables and metric equivalents of British weights and measures; coinage tables; and other similar information.

A memorandum to each member due to present a paper at the Session, stating the date, time and place of presentation.

Invitations to Receptions and other functions.

Other personal communications.

A Statement of Account, in cases where a balance of excursion payment was due.

In all, some 45,000 badges, documents and tickets were differentially sorted into the 1,500 personal wallets prepared before the Session; this work was well justified by the speed with which the actual business of registration could then be carried out. On arrival each member was first asked to sign the Register of the Session, and was then directed to the main Registry counter where his wallet awaited him. In addition to his wallet each member received a copy of the Geological Survey 25 miles/1 inch (1 : 584,000) map presented by the British Government; and each overseas member attending the Session received, as a further gift from H.M. Government, a complete set of a new edition of the 18

## PART I: GENERAL PROCEEDINGS

Geological Survey and Museum Handbooks of British Regional Geology, in special presentation cartons.

The Registry also included an internal post-office; an Information Counter; a bureau for the issue of ration documents; a stall for the sale of Day and Half-Day Excursion tickets; and facilities for luncheon reservations. Geological and topographical maps and a wide range of geological and general books and general guide-books were on sale at a special Publications Stall in the Main Hall of the Museum. Hammers and other field equipment were on sale in the Members' Lounge.

The first and last meetings of the General Assembly were held in the Royal Albert Hall. The meetings of the Council were held in the Lecture Hall of the Royal Geographical Society; this hall was also used for the Special Addresses to the General Assembly, for film shows, and for the meetings of Section M. The other Sectional meetings were held in the various lecture theatres of the Imperial College of Science and Technology. All these halls were conveniently near one to another, and to the Headquarters and Registry.

The Registry, Lecture theatres and other meeting places were staffed by a corps of some 60 stewards—volunteers from universities and from the Geological Survey and Museum staff. A group of Scouts from the 37th Kensington Troop served as messengers.

Changes of programme and other announcements were made known on notice boards in the Registry and in the Entrance Halls of the Geological Museum, the Imperial College of Science, and the Royal Geographical Society. Urgent announcements were also made through a public-address system in the Geological Survey and Museum building.

A full staff of professional interpreters qualified to deal with all the official languages was employed at the meetings of the Council and of the Bureau, and at some other major meetings. The proceedings were recorded *verbatim* by shorthand, in the English version.

It was not practicable to provide full staffs of interpreters for each of the Sectional and other technical meetings; but the Secretaries of these meetings could call upon the services of a central group of professional and volunteer interpreters, for assistance in special cases of language difficulty. Each member who took part in the discussions at these meetings was handed a Report Sheet by the stewards and asked to provide a written summary of his remarks.



## RECEPTIONS, EXHIBITIONS, LIBRARIES, AND FACILITIES

### RECEPTIONS

**A**N informal gathering of members and relatives was held in the Geological Museum on the evening of August 24th, before the formal opening of the Session. Dr. W. F. P. McLintock, Director of the Geological Survey and Museum, in welcoming the gathering, spoke as follows:—

“ Ladies and Gentlemen,

On behalf of my colleagues of the Geological Survey and Museum, I extend to you all a very hearty welcome to our Museum this evening. May I say that we think it a very great honour that you have assembled here tonight on the eve of one of the largest, if not the largest, congregations of geologists in the long history of the International Geological Congress. The story of this institution is part and parcel of the growth and development of our science. This Museum arose out of the activities of the Geological Survey over 100 years ago and it began as one or two rooms in a house long since demolished near Charing Cross. From there it blossomed out into the building at Jermyn Street, still remembered with affection by many of us here tonight, and where it grew and flourished for 83 years, by which time the plant had grown too big for the pot. So we had to build again with results that you see around you tonight.

This Museum was opened to the public in 1935 and it gives me particular pleasure to welcome here tonight many of our friends from abroad who honoured the opening ceremony and the Centenary of the Geological Survey by their presence here 13 years ago. During the period of the war we suffered the usual vicissitudes. We were hit twice by bombs; our exhibits were dismantled, our collections stored, and the galleries converted into offices. But we survived and last year we were able to complete the restoration of the Museum to its essential functions of education, culture and geological research. The Geological Survey and Museum have been in existence for 113 years; the International Geological Congress for 70 years. Are not these facts eloquent of the inherent strength, the vigour and vitality of our science ?

Ladies and Gentlemen, let me end as I began. We welcome you to our building tonight, and let me at the same time express the hope and belief that we are entering upon a successful and memorable session of the International Geological Congress.”

A Reception to all members and relatives was given by His Majesty's Government at Lancaster House on the evening of August 25th. The guests were received by The Right Honourable Viscount Addison, K.G., Lord Privy Seal.

A Reception to members specially interested in Pleistocene research was given by the Director of the University of London Institute of Archæology, Professor V. G. Childe, on the afternoon of August 26th.

At an afternoon Reception given by the Trustees of the British Museum on August 30th the guests were received in the British Museum (Natural History) by The Marquess of Cambridge, G.C.V.O.

Official delegates and their relatives were received by the Vice-Chancellor of the University of London, Professor D. Hughes Parry, at the Senate House of the University on the evening of August 30th.

On the same evening the Council of the Institute of Petroleum entertained the petroleum geologists present at the Session. The guests were received by the President of the Institute, Mr. E. A. Evans.

A Dinner in honour of Foreign Members of the Geological Society of London present at the Session was given in the Hall of the Worshipful Company of Tallowchandlers by the Geological Society Club on August 31st.

## PART I: GENERAL PROCEEDINGS

Later on the same evening a Reception to all members and relatives was given by the Geological Society of London in the rooms of that Society and of the Royal Society of London, in Burlington House. Guests were received by the President of the Geological Society, Professor H. H. Read.

### EXHIBITIONS

The following special exhibitions were arranged for members of the Session:—

A Special Exhibition of New British Mineralogical and Petrological Instruments, in the Geological Museum. Dr. A. F. Hallimond was responsible for the organization of this Exhibition, in conjunction with British firms manufacturing scientific instruments of this type.

Special Exhibits on Crystal Structure, in the Mineral Department of the British Museum (Natural History): and Special Exhibits on Palæontological Topics in the Geology Department of the British Museum (Natural History).

An Exhibition of Stone Age and Pleistocene Geology from the Cape to Britain: at the University of London Institute of Archæology.

Geological Publications and Maps submitted by members of the Congress were exhibited in the Registry and the Members' Lounge. Other exhibits in the Members' Lounge included a selection of photographs illustrating the use of aerial photography in geological surveying, by Hunting Aero-surveys, Ltd.; and models demonstrating the researches of Dr. George Slater on the contorted boulder clays of East Anglia.

### LIBRARIES

The Rooms and Library of the Geological Society of London in Burlington House, the Library of the Geological Survey and Museum, and the Libraries of the Departments of Geology and Mineralogy of the British Museum (Natural History) were open to members throughout the Session.

### FACILITIES

Restaurant and refreshment arrangements were organized by Mrs. V. A. Eyles. Reservations for luncheon in the Refectory of the Students' Union of Imperial College, or in restaurants near to the Headquarters of the Session, could be made in the Registry.

Certain special shopping facilities for members and relatives were arranged; and ladies attending the Session were invited to a fashion display by Messrs. Jaegers, Ltd., on August 27th. Mrs. C. J. Stubblefield carried out these arrangements.

The Travel Association provided an information bureau in the Registry.



## TIME-TABLE OF THE SESSION

THE time-table which is recorded below does not include the excursion programme, which is given on later pages; or the times of the separate meetings of the Commissions, which were determined by the Commissions themselves.

The Sectional Meetings, referred to by letters in the time-table, were as follows:—

- A. Problems of Geochemistry.
- B. Metasomatic Processes in Metamorphism.
- C. Rhythm in Sedimentation.
- D. The Geological Results of Applied Geophysics.
- E. The Geology of Petroleum.
- F. The Geology, Paragenesis and Reserves of the Ores of Lead and Zinc.
- G. The Geology of Sea and Ocean Floors.
- H. The Pliocene-Pleistocene Boundary.
- J. Faunal and Floral Facies and Zonal Correlation.
- K. The Correlation of Continental Vertebrate-bearing Rocks.
- L. Earth Movements and Organic Evolution.
- M. Other Subjects.

The open meetings of the Association des Services géologiques africains, and of the International Paleontological Union are also recorded in the time-table. The title “Clay Minerals Group” refers to special open meetings on Mineralogy and Geology of Clays which were organized in conjunction with the Clay Minerals Group of the Mineralogical Society of Great Britain and Ireland.

### TUESDAY, AUGUST 24<sup>TH</sup>

- 7-30 p.m. to 10-30 p.m. Informal Gathering in the Geological Museum.
- 8-30 p.m. Preliminary Meeting of the Council.

### WEDNESDAY, AUGUST 25<sup>TH</sup>

- 11-00 a.m. First General Assembly.
- 2-00 p.m. to 5-00 p.m. Sections A, C, K, M. Association des Services géologiques africains.
- 5-30 p.m. to 6-30 p.m. Meeting of the Council.
- 8-30 p.m. Reception by His Majesty's Government at Lancaster House.

### THURSDAY, AUGUST 26<sup>TH</sup>

- 9-00 a.m. to 10-00 a.m. First joint meeting of members of the Commissions.
- 10-30 a.m. to 12-30 p.m. Sections B, E, H, J, M.
- 2-00 p.m. to 5-00 p.m. Sections D and L. Clay Minerals Group.
- 3-30 p.m. Colour Film “The Virunga Volcanoes (Belgian Congo)” by Professor T. W. Gevers.
- 4-00 p.m. Reception by the Director of the University of London Institute of Archaeology at the Opening of the Exhibition of Stone Age and Pleistocene Geology from the Cape to Britain.
- 8-30 p.m. Address to the General Assembly by Professor O. T. Jones: “The Structural History of England and Wales.”

### FRIDAY, AUGUST 27<sup>TH</sup>

- 9-30 a.m. to 12-30 p.m. Sections F, G, M. Clay Minerals Group. International Paleontological Union.
- 2-00 p.m. to 5-00 p.m. Sections A, E, J. Association des Services géologiques africains.
- 5-30 p.m. to 6-30 p.m. Meeting of the Council.
- 8-30 p.m. Address to the General Assembly by Sir Edward Bailey: “The Structural History of Scotland.”

## PART I: GENERAL PROCEEDINGS

### SATURDAY, AUGUST 28<sup>TH</sup>

9-00 a.m. to 10-00 a.m. Resumed meeting of the Council.

10-30 a.m. to 12-30 p.m. Sections D, F; and Joint Meeting of Sections H and K.

2-00 p.m. to 5-00 p.m. Sections B, L.

8-30 p.m. Special Lecture and Colour Film by W. F. Foshag, F. H. Pough and J. G. Reyna: "Paricutin and Mexico's Volcanic Area."

### MONDAY, AUGUST 30<sup>TH</sup>

9-30 a.m. to 12-30 p.m. Sections A, G, J, M. Association des Services géologiques africains.

2-00 p.m. to 5-00 p.m. Sections C, D. Clay Minerals Group. International Paleontological Union.

2-30 p.m. Film and Lecture "The Fukui Earthquake of 28th June, 1948," presented by Mr. Sherman K. Neuschel.

3-30 p.m. to 6-00 p.m. Reception by the Trustees of the British Museum at the British Museum (Natural History).

5-30 p.m. to 6-30 p.m. Meeting of the Council.

8-30 p.m. Reception by the Senate of the University of London at the Senate House, London, W.C. 1.

8-30 p.m. Reception by the President and Council of the Institute of Petroleum at Manson House, Portland Place.

### TUESDAY, AUGUST 31<sup>ST</sup>

9-00 a.m. to 10-00 a.m. Business Meeting of the General Assembly.

10-30 a.m. to 12-30 p.m. Sections E, F, H, M. International Paleontological Union.

2-00 p.m. to 5-00 p.m. Sections B, K, M.

6-00 p.m. Geological Society Club Dinner in the Hall of The Worshipful Company of Tallowchandlers, Dowgate Hill, E.C.4.

9-00 p.m. Reception by the Geological Society of London at Burlington House, Piccadilly, W.1.

### WEDNESDAY, SEPTEMBER 1<sup>ST</sup>

10-30 a.m. Final Meeting of the General Assembly.

2-15 p.m. Meeting of the Bureau of the Eighteenth Session.

2-30 p.m. Repeated presentation of Special Lecture and Colour Film by W. F. Foshag, F. H. Pough and J. G. Reyna: "Paricutin and Mexico's Volcanic Area."

5-00 p.m. Repeated presentation of Colour Film "The Virunga Volcanoes (Belgian Congo)" by Professor T. W. Gevers.

## EXCURSIONS PROGRAMME

THE work of designing the excursions programme presented certain special problems and difficulties. The responsible Committees were anxious to arrange a programme of sufficient variety to fulfil the needs of members who wished to make some general tour of Britain; of those who wished to examine in detail some smaller classic area of the country; of those with but limited time to spare, either before or after the Session in London; and of those who were unable to join any long excursions but were anxious to see as much geology in the field as possible during the dates of the Session in London. It was not easy, particularly in view of fluctuating international conditions, to judge long in advance even the approximate demand for excursion places; yet because of the heavy general post-war demand in Great Britain upon the available hotel accommodation, not fully restored from the constriction and damage of the war, it was essential to initiate reservations for many of the excursion parties twelve months or more before the Session.

### LONG (A & C) EXCURSIONS

With these matters in mind, a detailed programme of long excursions was devised and announced in the Third Circular. The response to this Circular was very great. It was clear that there was vast interest abroad in the Session and its excursions, and that the excursion programme as it stood might prove insufficient to accommodate all those who wished to take part, even after good allowance had been made for reduction in the number of final applications for places by normal incident and accident; though at the same time the possible effect of major changes in national or international conditions was realized.

It was decided to make a number of additions to the programme of long excursions. In designing these additions, the Committees were largely guided by comments and suggestions received in reply to the Third Circular. They included several special non-geological tours for the relatives of members. The full programme was announced in the Fourth Circular.

In the section of this Report which outlines the history of the organization of the Session, the grave hindrances to international travel which arose during January to July, 1948, have already been mentioned. They did not, in the event, much reduce the attendance at the Session; but they included severe currency restrictions which prevented substantial numbers of members who attended from taking places on the long excursions. During the final preparatory period, therefore, it was necessary to make cuts in the excursion programme. Several long excursions were cancelled, and the numbers in the parties of some others were reduced. The total number of places finally booked was about 800, less than had earlier seemed probable, but nevertheless a very substantial number even in comparison with previous Sessions.

In the summary of the programme which is given in following pages all the excursions which were prepared are mentioned. Asterisks indicate those eventually cancelled because of the reduced demand.

A new edition of the set of eighteen Handbooks on British Regional Geology, prepared by the Geological Survey and Museum, was used as guides to the general geology of England, Wales and Scotland. A complete set of these handbooks was presented by the British Government to all members who attended the Session from countries abroad. The Directors of the excursion to East Ireland prepared a general guide to the geology of that region which was printed in format similar to that of the Regional Handbooks. To supplement these systematic regional descriptions, 35 special guides describing the detailed itineraries of each of the long excursions were prepared by the respective excursions directors. These were mimeographed, and appropriately distributed to the members of the excursions.



## DAY AND HALF-DAY (B) EXCURSIONS

The programme of short excursions and visits centred on London lasted from August 21st to September 5th. It was not possible to judge in advance what the demand for such excursions would be in relation to other simultaneous items in the programme of the Session; but since no problems of overnight accommodation were involved, it was possible to plan an extensive programme with arrangements for its reduction at short notice according to the actual demand. The Officers and members of the Geologists' Association, which has long experience in the organization of excursions in the London area, played a major part in devising and leading the programme. It contained 97 items, including a number of repeated excursions, and of these 64 were actually run. The majority of the items, while primarily planned for the study of the geology of south-eastern England, also offered opportunity of general views of the countryside and of visiting places of historical or archaeological interest. Some excursions were of more specialized nature, covering particular formations in detail. There was also a number of visits to scientific institutions.

A special Programme of Day and Half-Day (B) Excursions, issued to each member on registration, gave full details of the itinerary of each excursion. The summary of the excursion programme given below indicates only the principal objective of each B excursion, and its leaders.

## SUMMARY OF EXCURSIONS

## A. LONG EXCURSIONS BEFORE THE SESSION

*A.1. Economic Geology of England and Wales*

Centres: Doncaster, Durham, Penrith, Penmaenmawr, Chester, Leicester  
(first party), Rugby (second party).

First party: August 10th to 22nd.

Second party: August 12th to 24th.

Transport: motor-coach throughout, about 1,400 miles.

A tour of deposits of economic importance in central and northern England and Wales.

Directors: K. C. Dunham, J. H. Taylor. Associate Directors: P. G. H. Boswell, Wilfrid Edwards, W. G. Fearnside, G. S. Gowing, H. H. Gregory, S. E. Hollingworth, R. C. B. Jones, T. Robertson, G. R. Schnellmann, J. Shirley, F. M. Trotter.

*A.2. North-West of England*

Centre: Kendal, Westmorland.

August 7th to 21st.

Transport: locally by motor-coach.

Ordovician and Silurian sediments; intrusions; tectonics; Carboniferous sediments; Great Whin Sill; glacial phenomena.

Director: W. B. R. King. Secretary: G. H. Mitchell. Associate Directors: S. E. Hollingworth, T. C. Nicholas, W. C. C. Rose, F. W. Shotton, H. C. Versey, W. H. Wilcockson.

*A.3. William Smith Excursion (Environs of Bath)*

Centre: Bath.

August 17th to 24th.

Transport: motor-coach throughout.

Demonstration of the Upper Palaeozoic and Mesozoic succession in the classic area in which William Smith discovered the fundamental principles of stratigraphy and determined the order of succession of the strata.

Directors: L. R. Cox, G. A. Kellaway, F. B. A. Welch. Secretary: G. A. Kellaway.

*A.4. Devon and Cornwall (Mineralogical)*

Centres: Launceston and Penzance.

August 9th to 21st.

Transport: motor-coach throughout.

Mineralogy.

Director: Sir Arthur Russell. Secretary: G. F. Claringbull. Associate Directors: L. Caunter, A. K. Hamilton-Jenkin, A. Kingsbury.

## EXCURSIONS

### Summary of Excursions—continued.

#### A.5. *Devon and Cornwall (General) (Duplicate of C.5)*

Centres: Exeter and Newquay.

August 9th to 21st.

Transport: motor-coach throughout.

Stratigraphy (mainly Devonian and Carboniferous), igneous rocks, metamorphic rocks, mineralization, etc.

Directors: H. G. Dines and J. Robson. Secretary: J. Robson. Associate Directors: L. G. Anniss, H. Dewey, Eileen M. L. Hendriks, C. E. Leese, D. E. Owen, J. B. Scrivenor, Stanley Smith, C. E. Tilley.

#### A.6. *Oxford District*

Headquarters: The Queen's College, Oxford.

August 17th to 24th.

Transport: locally by motor-coach.

Jurassic, Lower Cretaceous and Pleistocene rocks of South Midlands.

Director: W. J. Arkell. Secretary: J. M. Edmonds. Associate Directors: J. A. Douglas, K. S. Sandford.

#### A.7. *Midlands of England\**

Centre: University Hall of Residence, Edgbaston, Birmingham.

August 14th to 21st.

Transport: motor-coach throughout.

Palaeozoic and Triassic stratigraphy and tectonics.

Director: L. J. Wills. Secretary: C. E. Marshall. Associate Directors: W. G. Hardie, E. D. Lacey, J. W. Pallister, R. W. Pocock, H. B. Whittington.

#### A.8. *Dorset Coast*

Centre: Weymouth.

August 14th to 21st.

Transport: locally by motor-coach and boat.

Tectonics and stratigraphy of the Dorset coast from Lyme Regis to Swanage.

Director: P. C. Sylvester-Bradley. Secretary: R. V. Melville. Associate Directors: G. Bomford, W. Heap, S. W. Hester, W. D. Lang.

#### A.9. *Pennines*

Centres: Skipton and Buxton.

August 8th to 21st.

Transport: locally by motor-coach.

Mainly Carboniferous stratigraphy, with some Pre-Cambrian and Lower Palaeozoic rocks.

Directors: F. Wolverson Cope and R. G. S. Hudson. Secretary: R. A. Eden. Associate Directors: W. S. Bisat, J. W. Jackson, E. W. J. Moore, D. Parkinson, J. E. Prentice, J. Shirley, F. Sutcliffe.

#### A.10. *South Wales*

Centres: Cardiff, Swansea and Fishguard.

August 11th to 23rd.

Transport: locally by motor-coach.

Stratigraphy and tectonics of South Wales.

Director: A. H. Cox. Secretary: A. Stuart. Associate Directors: T. N. George, L. R. Moore, F. J. North, A. E. Trueman, W. D. Ware.

#### A.11. *London to Wales (Geomorphology)*

August 14th to 24th.

Transport: motor-coach throughout.

Geomorphology of the South of England and parts of Wales.

Directors: S. W. Wooldridge and A. A. Miller. Secretaries: W. G. V. Balchin and Miss E. M. J. Campbell.

#### A.12. *Mull and Ardnamurchan*

Centres: Salen and Kilchoan.

August 6th to 22nd.

Transport: locally by car and steamer.

Tertiary igneous complexes; Caledonian granite; Lewisian; Mesozoic sediments.

Directors: E. B. Bailey and J. E. Richey. Secretary: J. A. Watson. Associate Director: M. K. Wells.

## PART I: GENERAL PROCEEDINGS

### Summary of Excursions—continued.

#### A.13. *Skye*

Centre: Portree.  
August 13th to 22nd.  
Transport: locally by motor-bus.

Mesozoic; Cambrian; Tertiary igneous rocks.

Director: F. W. Anderson. Secretary and Associate Director: J. Knox.

#### A.14. *North-West Highlands*

Centres: Inchnadamph and Durness.  
August 6th to 22nd.  
Transport: locally by motor-bus.

Lewisian schists and gneisses; Moine Schists; Cambro-Ordovician; overthrust tectonics.

Directors: Murray Macgregor, J. Phemister, V. Wilson. Secretary: J. A. Watson. Associate Director: A. T. Dollar.

#### A.15. *Arran and South-West Scotland*

Centres: Brodick and Ayr.  
August 6th to 22nd.  
Transport: locally by motor-bus and steamer.

Tertiary and earlier igneous rocks; sedimentaries from Ordovician to Trias; glacial geology.

Directors: G. W. Tyrrell and J. B. Simpson. Secretary: N. Holgate. Associate Directors: J. Begg, H. J. W. Brown, W. R. Flett, J. Knox, W. Manson, M. V. N. Murthy, M. S. Rao, J. Weir.

#### A.16. *South-West Highlands* Centre: Oban.

August 6th to 22nd.  
Transport: locally by motor-bus, rail and motor-boat.

Moine and Dalradian metamorphic rocks; Old Red Sandstone; Tertiary igneous rocks.

Director: J. G. C. Anderson. Secretary: J. A. Watson.

#### A.17. (Duplicate of C.17). *East Anglia\**

Centres: Ipswich and Norwich.  
August 17th to 24th.  
Transport: locally by motor-coach.

Cretaceous, Tertiary and Pleistocene stratigraphy; glacial and coastal phenomena; early man. Visits to Ipswich and Norwich Museums.

Directors: C. D. Ovey, D. F. W. Baden-Powell. Secretary: W. E. Smith. Associate Directors: J. P. T. Burchell, G. Maynard, J. E. Sainty, H. E. P. Spencer, J. A. Steers.

#### A.18. *Hydrogeology of England and Wales*

August 9th to 24th.  
Transport: about 1,500 miles by motor-coach throughout.

Upland, river and underground water resources in England and Wales.

Director: S. Buchan. Secretaries: T. K. Tate, Miss C. M. Willis.

#### A.19. *General Geology of Scotland* August 10th to 23rd.

Transport: locally by motor-coach.

Geology of the route Glasgow—Fort William—Strathpeffer—Aberdeen—St. Andrews—Edinburgh.

Directors: T. C. Phemister and A. G. MacGregor. Secretary: T. C. Phemister.

#### Relatives' Tour, A.20. *Cathedral Cities and English and Scottish Lake Districts*

August 7th to 22nd.

#### Relatives' Tour, A.21. *Shakespeare's Country, English Lakes and Cathedral Cities\**

August 14th to 22nd.

#### Relatives' Tour, A.22. *Shakespeare's Country, Wye Valley and Mid-Wales\**

August 14th to 21st.

## B. DAY AND HALF-DAY EXCURSIONS

### August 21st

B. 1. Hindhead and Midhurst. Day. Duplicate of B.55. Leader: I. F. Higginbottom.

B. 2. The Chilterns (Dunstable and Tring). Day. Leaders: P. Evans and K. P. Oakley.

### August 22nd

B. 3. London to Devil's Dyke, Brighton. Day. Duplicate of B.47. Leaders: A. J. Bull and J. F. Kirkaldy.

B. 4. Reading and Kingsclere. Day. Leaders: H. L. Hawkins and W. S. Pitcher.

B. 5. Box Hill, Dorking, Surrey. Half-Day. Duplicate of B.22 and B.41. Leader: C. C. Fagg.

B. 6. Leith Hill, Surrey. Half-Day. Duplicate of B.19, B.31, B.49, B.82. Leader: G. Wilson.



## EXCURSIONS

### B. Day and Half-day Excursions—*continued*.

*August 23rd*

- B. 7. Mountfield Gypsum Mines, Robertsbridge. Day. Leader: B. C. G. Worssam.
- B. 8. Traverse of Sussex to Beachy Head. Day. Duplicate of B.46 and B.95. Leader: H. Dighton Thomas.
- B. 9. Rye and Dungeness. Day. Leaders: T. W. Marsh and R. H. Spires.
- B.10. Charlton, Abbey Wood and Plumstead. Half-Day. Duplicate of B.90. Leaders: F. J. Epps and W. S. Pitcher.
- B.11. Building Research Station, Watford. Half-Day. Leader: Miss H. Pike.
- B.12. Oxted and Coulsdon. Half-Day. Duplicate of B.25. Leader: S. C. A. Holmes.

*August 24th*

- B.13. Dorking and Chichester. Day. Duplicate of B.91. Leader: C. C. Fagg.
- B.14. Crowhurst, Telham Hill, Battle. Day. Leader: G. S. Sweeting.
- B.15. North-West Weald. Day. Leader: J. F. Kirkaldy.
- B.16. Banbury and Sulgrave Manor. Day. Leader: V. Wilson.
- B.17. Sedgwick Museum and Department of Mineralogy and Petrology, Cambridge. Day. Leaders: W. B. R. King, C. E. Tilley.
- B.18. Clandon and Newlands Corner, Surrey. Half-Day. Duplicate of B.32, B.50, B.67, B.83. Leader: T. Barnard.
- B.19. Leith Hill, Surrey. Half-Day. Duplicate of B.6. Leader: B. C. G. Worssam.
- B.20. North Mimms, Hertfordshire. Half-Day. Duplicate of B.75. Leader: J. F. Kirkaldy.
- B.21. Royal Botanic Gardens, Kew. Half-Day. Duplicate of B.70. Leader: J. Ineson.

*August 25th*

- B.22. Box Hill, Dorking, Surrey. Half-Day. Duplicate of B.5. Leader: F. G. Blyth.
- B.23. Horsley, Netley Heath and Newlands Corner. Half-Day. Duplicate of B.42 and B.56. Leader: T. Barnard.
- B.24. Fuel Research Station, Greenwich. Half-Day. Duplicate of B.68. Leader: G. W. Himus.
- B.25. Oxted and Coulsdon. Half-Day. Duplicate of B.12. Leader: S. C. A. Holmes.

*August 26th*

- B.26. Worthing, Sussex. Day. Leader: E. C. Martin.
- B.27. Aylesbury and Princes Risborough. Day. Leaders: A. Morley Davies and V. Wilson.
- B.28. Wrotham and Folkestone, Kent. Day. Duplicate of B.80. Leader: R. Casey.
- B.29. Bletchley. Day. Leader: P. E. Kent.
- B.30. Jealott's Hill, Maidenhead. Day. Leader: F. H. Edmunds.
- B.31. Leith Hill, Surrey. Half-Day. Duplicate of B.6. Leader: M. K. Wells.
- B.32. Clandon and Newlands Corner, Surrey. Half-Day. Duplicate of B.18. Leader: D. Curry.
- B.33. Building Research Station, Watford. Half-Day. Duplicate of B.11. Leader: Gwyn Thomas.
- B.34. Brighton. Half-Day. Duplicate of B.69. Leader: G. A. Kellaway.
- B.35. London's Water Supply. Half-Day. Duplicate of B.77. Leader: S. Buchan.

*August 27th*

- B.36. Agricultural Soils of Kent: "The Garden of England." Day. Duplicate of B.61. Leader: B. S. Furneaux.
- B.37. Northampton. Day. Leader: A. W. Woodland.
- B.38. Gypsum Mines, Robertsbridge. Day. Duplicate of B.7. Leader: S. Buchan.
- B.39. St. Albans, Codicote and the Hitchin Valley. Day. Leaders: S. W. Wooldridge and R. O. Warburg.
- B.40. Guildford and Hog's Back, Surrey. Half-Day. Duplicate of B.60 and B.74. Leader: R. O. Jones.
- B.41. Box Hill, Dorking, Surrey. Half-Day. Duplicate of B.5. Leader: G. E. Hutchings.
- B.42. Horsley, Netley Heath and Newlands Corner. Half-Day. Duplicate of B.23 and B.56. Leader: G. Wilson.
- B.43. Down House, Downe, Kent. Half-Day. Duplicate of B.84. Leader: A. G. Bell.
- B.44. Road Research Laboratory, West Drayton. Half-Day. Duplicate of B.78. Leader: G. Bisson.

*August 28th*

- B.45. Agricultural Land Drainage in Surrey. Day. Duplicate of B.79. Leader: W. H. Rivett.
- B.46. Traverse of Sussex to Beachy Head. Day. Duplicate of B.8. Leader: H. Dighton Thomas.
- B.47. London to Devil's Dyke, Brighton. Day. Duplicate of B.3. Leaders: A. J. Bull and J. F. Kirkaldy.
- B.48. Oxford University Museum. Day. Leaders: J. A. Douglas and R. O. Jones.
- B.49. Leith Hill, Surrey. Half-Day. Duplicate of B.6. Leader: Gwyn Thomas.
- B.50. Clandon and Newlands Corner, Surrey. Half-Day. Duplicate of B.18. Leader: R. H. Spires.
- B.51. Dunton Green, Kent. Half-Day. Leader: C. W. Wright.
- B.52. Swanscombe, Kent. Half-Day. Leaders: W. B. R. King and K. P. Oakley.

## PART I: GENERAL PROCEEDINGS

### B. Day and Half-day Excursions—*continued*.

#### *August 29th*

- B.53. Leighton Buzzard. Day. Leader: C. W. Wright.
- B.54. Fairlight and Rye. Day. Leader: G. Wilson.
- B.55. Hindhead and Midhurst. Day. Duplicate of B.1. Leader: R. M. Shackleton.
- B.56. Horsley, Netley Heath and Newlands Corner. Day. Duplicate of B.23 and B.42. Leader: T. Barnard.
- B.57. Leatherhead and Boxhill, Dorking, Surrey. Half-Day. Leader: F. H. Edmunds.
- B.58. Stones of London's Buildings. Half-Day. Leader: R. J. Schaffer.
- B.59. An Afternoon Stroll in London. Half-Day. Leader: C. N. Bromehead.
- B.60. Guildford and Hog's Back, Surrey. Half-Day. Duplicate of B.40. Leader: R. O. Jones.

#### *August 30th*

- B.61. Agricultural Soils of Kent: "The Garden of England." Day. Duplicate of B.36. Leader: B. S. Furneaux.
- B.62. Bexhill and Pevensey. Day. Leader: G. MacDonald Davies.
- B.63. Southborough, Tunbridge Wells and Eridge. Day. Leader: G. S. Sweeting.
- B.64. Isle of Sheppey, Kent. Day. Leader: G. F. Elliott.
- B.65. Hunting Aerosurveys, Elstree. Half-Day. Leader: J. R. Shelford.
- B.66. Dorking, Betchworth, Headley and Leatherhead. Half-Day. Leader: G. Wilson.
- B.67. Clandon and Newlands Corner, Surrey. Half-Day. Duplicate of B.18. Leader: D. A. Brown.
- B.68. Fuel Research Station, Greenwich. Half-Day. Duplicate of B.24. Leader: G. W. Himus.
- B.69. Brighton. Half-Day. Duplicate of B.34. Leader: G. A. Kellaway.
- B.70. Royal Botanic Gardens, Kew. Half-Day. Duplicate of B.21. Leader: G. W. Green.

#### *August 31st*

- B.71. Tonbridge, Horsham and Dorking. Day. Duplicate of B.81. Leaders: J. R. Harding and S. C. A. Holmes.
- B.72. Herne Bay and Canterbury, Kent. Day. Leaders: A. Wrigley and W. S. Pitcher.
- B.73. Dover. Day. Leaders: A. H. Toms and F. H. Edmunds.
- B.74. Guildford and Hog's Back. Half-Day. Duplicate of B.40. Leader: J. Ineson.
- B.75. North Mimms, Hertfordshire. Half-Day. Duplicate of B.20. Leader: J. F. Kirkaldy.
- B.76. Harefield. Half-Day. Leader: S. W. Hester.
- B.77. London's Water Supply. Half-Day. Duplicate of B.35. Leader: S. Buchan.
- B.78. Road Research Laboratory, West Drayton. Half-Day. Duplicate of B.44. Leader: I. P. Stevenson.

#### *September 1st*

- B.79. Agricultural Land Drainage in Surrey. Day. Duplicate of B.45. Leader: W. H. Rivett.
- B.80. Wrotham and Folkestone, Kent. Day. Duplicate of B.28. Leader: R. Casey.
- B.81. Tonbridge, Horsham and Dorking. Day. Duplicate of B.71. Leader: J. R. Harding.
- B.82. Leith Hill, Surrey. Half-Day. Duplicate of B.6. Leader: R. M. Shackleton.
- B.83. Clandon and Newlands Corner, Surrey. Half-Day. Duplicate of B.18. Leader: Gwyn Thomas.
- B.84. Down House, Downe, Kent. Half-Day. Duplicate of B.43. Leader: A. G. Bell.
- B.85. Rothamsted Experimental Station. Half-Day. Leader: J. Ineson.

#### *September 2nd*

- B.86. Wrotham Heath. Day. Leaders: E. E. S. Brown and G. W. Himus.
- B.87. Lewes, Sussex. Day. Leader: C. T. Gaster.
- B.88. Pagham Harbour and Bognor Regis. Day. Leader: E. M. Venables.
- B.89. Barrington, Cambridge. Day. Leader: W. B. R. King.
- B.90. Charlton, Abbey Wood and Plumstead. Half-Day. Duplicate of B.10. Leader: W. S. Pitcher.

#### *September 3rd*

- B.91. Dorking and Chichester. Day. Duplicate of B.13. Leader: G. E. Hutchings.
- B.92. Windsor, Henley and Nettlebed. Day. Leader: H. L. Hawkins.
- B.93. Trundle Hill and Bracklesham Bay. Day. Leader: E. M. Venables.

#### *September 4th*

- B.94. Westerham, Sevenoaks and Tonbridge. Day. Leaders: A. J. Bull and G. S. Sweeting.

#### *September 5th*

- B.95. Traverse of Sussex to Beachy Head. Day. Duplicate of B.8. Leader: F. H. Edmunds.

## EXCURSIONS

### C. LONG EXCURSIONS AFTER THE SESSION

#### C.1. *England and Wales*

Party A: September 2nd to 14th.

Party B: September 4th to 16th.

Transport: motor-coach throughout (about 1,400 miles).

General geology and topography.

Directors: T. Eastwood, S. E. Hollingworth. Secretary: V. Wilson. Associate Directors: G. Bisson, W. G. Fearn-sides, H. H. Gregory, G. A. Kellaway, G. H. Mitchell, R. W. Pocock, C. J. Stubblefield, F. B. A. Welch, D. Williams.

#### C.2. *East Yorkshire*

Centres: Leeds and Scarborough.

September 2nd to 11th.

Transport: motor-coach throughout.

Principally Jurassic and Cretaceous stratigraphy and sedimentation, glacial phenomena and geomorphology. Also sections in the Upper Carboniferous, Permian and Trias.

Directors: H. C. Versey and J. E. Hemingway. Secretary: J. E. Hemingway. Associate Directors: L. Bairstow, T. Harris, C. W. Wright.

#### C.3. *Bristol District\**

Centre: Bristol.

Transport: locally by motor-coach.

Silurian, Devonian, Carboniferous and Jurassic stratigraphy.

Director: W. F. Whittard. Secretary: F. S. Wallis. Associate Directors: A. Morley Davies, D. T. Donovan, G. A. Kellaway, I. S. Loupekine, L. R. Moore, L. S. Palmer, S. H. Reynolds, Stanley Smith, A. E. Trueman, F. B. A. Welch.

#### C.4. *East Midlands\**

Centre: Nottingham.

September 2nd to 10th.

Transport: locally by motor-coach.

Pre-Cambrian (sedimentary and igneous), Carboniferous, Permian, Triassic, Jurassic and Cretaceous; Derbyshire and Nottinghamshire Coalfield, Eakring Oilfield and Mesozoic iron ores.

Directors: C. E. Marshall and H. H. Swinnerton. Secretary: W. W. Black. Associate Directors: Wilfrid Edwards, H. H. Gregory, P. E. Kent, J. Shirley, Vernon Wilson.

#### C.5. *(Duplicate of A.5.) Devon and Cornwall (General)*

Centres: Exeter and Newquay.

September 6th to 18th.

Transport: motor-coach throughout.

#### C.6. *North Wales and Shropshire*

Centres: Bangor and Shrewsbury.

September 2nd to 16th.

Transport: motor-coach throughout.

Demonstration of the Lower Palaeozoic succession in the districts made classic by the early researches of Murchison and Sedgwick.

Director: W. G. Fearn-sides. Secretary: C. J. Stubblefield. Associate Directors: O. M. B. Bulman, A. J. Butler, W. Davies, Gertrude L. Elles, E. Greenly, W. B. R. King, R. W. Pocock, W. J. Pugh, J. Shirley, S. H. Straw, H. B. Whittington, W. F. Whittard, D. Williams, A. W. Woodland.

#### C.7. *Central and South-West Wales*

Centres: Builth Wells and Fishguard.

September 2nd to 16th.

Transport: motor-coach throughout.

Palaeozoic and Pre-Cambrian of Central Wales and Pembrokeshire.

Directors: A. H. Cox, O. T. Jones, W. J. Pugh. Secretary: W. D. Evans. Associate Directors: J. Challinor, S. H. Straw.

#### C.8. *Isle of Wight*

Centre: Shanklin.

September 4th to 11th.

Cretaceous, Eocene and Oligocene stratigraphy; tectonics of the island.

Director: H. L. Hawkins. Secretary: Phoebe S. Walder. Associate Director: D. Curry.

#### C.9. *North-East Coast\**

Centres: Newcastle and Wooler.

September 4th to 17th

Transport: locally by motor-coach.

North-eastern facies of Permian and Lower Carboniferous; Old Red Sandstone and Carboniferous volcanics and intrusions; northern glacial phenomena.

Directors: H. G. A. Hickling and T. Robertson. Secretary: S. I. Tomkeieff. Associate Directors: W. Anderson, G. A. Burnett, C. T. Trechmann.



## PART I: GENERAL PROCEEDINGS

### C. Long Excursions after the Session—*continued*.

#### C.10. *East Ireland*

Centres: Belfast and Dublin.

September 1st to 17th.

Transport in Ireland: motor-coach and railway.

Most systems from Pre-Cambrian onwards; Devonian and Tertiary igneous phenomena.

Directors: D. W. Bishopp, J. K. Charlesworth, J. J. Hartley, H. J. Seymour, L. B. Smyth. Secretary: A. Farrington.  
Associate Directors: J. Brindley, G. F. Mitchell, S. I. Tomkeieff.

#### C.11. *Ben Nevis—Glencoe—Ballachulish Area*

Centres: Ballachulish and Fort William.

September 3rd to 19th.

Dalradian schists, tectonics; Caledonian granites, cauldron-subsidences; glacial geology.

Directors: E. B. Bailey and J. G. C. Anderson. Secretary: J. A. Watson.

#### C.12. *East Highlands*

Centres: Aberdeen and Brora.

September 3rd to 19th.

Transport: locally by motor-bus and rail.

Caledonian igneous rocks; Highland schists; Mesozoic sediments.

Directors: T. C. Phemister and J. Weir. Secretary: A. K. Pringle. Associate Directors: R. Campbell, W. E. Fraser,  
A. K. Pringle, S. Simpson, J. Watson.

#### C.13. *Edinburgh and St. Andrews Areas*

Centres: Edinburgh and St. Andrews.

September 3rd to 19th.

Transport: locally by motor-bus and rail.

Ordovician to Carboniferous sediments; Old Red Sandstone and Permo-Carboniferous igneous rocks; glacial geology.

Directors: A. G. MacGregor and D. E. Innes. Secretary: T. H. Whitehead. Associate Directors: G. Y. Craig,  
G. A. Cumming, R. Eckford, T. M. Finlay, J. Knox, W. Manson, J. B. Simpson, J. Wright.

#### C.14. *Skye and Morar*

Centres: Sligachan, Broadford and Mallaig.

September 2nd to 19th.

Transport: motor-bus, car, steamer, motor-boat.

Directors: F. H. Stewart and L. R. Wager. Secretary: J. A. Watson. Associate Directors: F. W. Anderson,  
E. A. Vincent.

#### C.15. *Glasgow District\**

Centre: Glasgow.

September 3rd to 11th.

Transport: locally by motor-coach.

Dalradian schists; Palaeozoic sediments; igneous rocks of various ages.

Director: G. W. Tyrrell. Secretary: N. Holgate. Associate Directors: G. W. Bennison, G. Y. Craig, Miss E. D. Currie, A. T. Dollar, W. R. Flett, S. M. K. Henderson.

#### C.16. *Vertebrate Palaeontology*

September 2nd to 18th.

Transport: motor-coach London to Thurso.

Vertebrate-bearing horizons in the Welsh Borderlands, and Scotland.

Directors: D. M. S. Watson, T. S. Westoll, E. I. White. Secretary: H. A. Toombs.

#### C.17. *(Duplicate of A.17). East Anglia*

Centres: Ipswich and Norwich.

September 2nd to 9th.

#### C.18. *Jersey\**

Centre: St. Helier.

September 2nd to 10th.

Transport: locally by motor-coach.

The igneous phenomena and age relations of the Pre-Cambrian and ? Cambrian rock groups in Jersey.

Directors: A. E. Maurant and A. K. Wells. Secretary: A. J. Robinson. Associate Director: Miss M. Casimir.

#### *Relatives' Tour, C.19. Cathedral Cities and English and Scottish Lake Districts\**

September 2nd to 17th.

#### *Relatives' Tour, C.20. Shakespeare's Country, Wye Valley and Mid-Wales\**

September 2nd to 9th.

**Mr. FREDERICK NOEL ASHCROFT**

We record with deep regret the death on April 4th, 1949, of Mr. F. N. Ashcroft, the Treasurer of the Eighteenth Session. Mr. Ashcroft undertook the heavy responsibility of that office in 1938, and served throughout both the pre-war and the post-war periods of organization. He carried out personally, with meticulous accuracy, the great body of detailed accountancy of the Session. His arduous task continued without respite for many months after its close. Finally, only a few days before his death, he presented to the Council of the Geological Society of London a completed financial statement which is summarized in the following pages.

His work for the International Geological Congress was the last act in a long life devoted in large measure to generous voluntary labour on behalf of the geological and mineralogical sciences.

# FINANCIAL STATEMENT:

RECEIPTS.	£	s.	d.	£	s.	d.
By GENERAL FUNDS—						
Donations to Congress Funds—						
1. From Fellows of the Geological Society.....	1176	6	0			
2. From the Geological Society.....	1000	0	0			
3. From Kindred Institutions .....	765	5	0			
4. From Industrial Undertakings .....	3982	12	0			
				6924	3	0
Membership Fees .....				3536	0	0
Sale of Publications issued prior to the Session.....				336	6	5
Deposit Interest—						
1. Deposit Account at Bankers .....	36	0	1			
2. Post Office Savings Bank Account .....	249	11	9			
				285	11	10
Small Receipts .....				3	14	9
Total General Funds .....				11085	16	0
EXCURSION RECEIPTS—						
I. "A" and "C" (long) Excursions—						
1. Sale of Tickets and Deposits .....	23286	5	7			
2. Leaders' Official Allowances .....	790	18	8			
3. Supernumeraries (part-time participants).....	136	9	7			
4. Other Receipts .....	30	15	3			
				24244	9	1
II. "B" (short) Excursions—						
Sale of Tickets .....				1103	4	6
				£36433	9	7

## NOTES:—

- The above statement covers all moneys received and paid out by the Executive Committee up to February 28th, 1949, except the Spendiarov Prize (see Note No. 5). It does not include the cost of printing and distributing the Report of the Congress estimated at approximately £9,000, nor does it relate to the very substantial contributions to the organization of the Session which were made by His Majesty's Government in the form of the preparation and presentation of Maps, Handbooks and Itineraries and the provision of Accommodation, Services and Staff.
- The known outstanding liabilities on February 28th, 1949, amounted to approximately £52. There was also a contingent liability of £7. 10s.
- Of the General Expenditure, £7,697. 19s. 8d., the sum of £1,173. 5s. 3d. had been expended by April 18th, 1940, when, liabilities having been cleared, the accounts were closed in consequence of the postponement *sine die* of the Session originally planned to be held in 1940. Much of the preparatory work done in 1938 and 1939 had to be revised and some of it started afresh.
- Since February 1st, 1949, the sum of £1,500 has been received as donations towards the cost of the Report of the Congress. Of this £1,000 was received before February 28th, 1949, and is included in the above statement of accounts.
- Spendiarov Prize*.—The sum of £50 was received from the Government of the U.S.S.R. in respect of this prize and was at once transmitted to the recipient of the Prize. This transaction is not included in the above statement, as the accounts relate only to moneys controlled by the Executive Committee.

F. N. ASHCROFT, *Treasurer*.



# TO FEBRUARY 28th, 1949

PAYMENTS.		£	s.	d.	£	s.	d.
To GENERAL EXPENDITURE—							
Preliminary Expenses and Appeals for Funds.....			47	7	2		
Salaries and Insurance of Staff .....			2140	8	5		
Stationery and Office Equipment.....			679	8	4		
Indexing, Typing and Duplicating (external work) .....			187	8	11		
Circulars: Printing, Addressing, Postage, etc.—							
1. First Circular, 1938. Edition 25,950 copies .....	165	19	7				
2. Second Circular, 1939. Edition 26,625 copies.....	247	6	2				
3. Third Circular, 1947. Edition 26,000 copies .....	472	13	9				
4. Fourth Circular, 1947. Edition 4,000 copies.....	179	18	3				
5. Fifth Circular, 1948. Edition 3,500 copies .....	58	10	5				
					1124	8	2
Invitations to appoint Delegates: Printing and Postage, etc.—							
1. For 1940 Session, 1939 .....	28	1	5				
2. For 1948 Session, 1947 .....	36	13	9				
					64	15	2
Publications issued prior to the Session—							
Provisional List of Registrants, Titles and Abstracts of Papers, Symposium on the Ores of Lead and Zinc, Programme of Meetings and of “ B ” (short) Excursions, etc. ....					1777	1	11
Secretarial Postage, Telegrams, Receipt Stamps, etc.....					254	0	10
Expenses of Meetings—							
1. Interpreters and Reporters .....	334	15	6				
2. Hire of Halls and miscellaneous related Expenditure .....	537	14	4				
					872	9	10
Travelling Expenses of Stewards .....			37	2	6		
Congress Badges and Stewards’ Badges .....			174	4	5		
Translation of Council Papers .....			78	18	0		
Miscellaneous Expenditure, Bank Charges and Cheque Books, Foreign Exchange Losses, etc. ....			90	14	6		
Audit Fees, Legal and Professional Assistance .....			169	11	6		
Total General Expenditure .....			7697	19	8		
EXPENDITURE ON EXCURSIONS—							
“ A ” and “ C ” (long) Excursions.....	23071	5	10				
“ B ” (short) Excursions .....	1094	18	9				
					24166	4	7
					31864	4	3
BALANCES at Bankers, in the Post Office Savings Bank, and in hand, February 28th, 1949 .....			4569	5	4		
					£36433	9	7

March 14th, 1949.

F. N. ASHCROFT, *Treasurer.*

We have examined the above Account with the Books and Vouchers and certify it to be in accordance therewith and in our opinion correct. We have verified the balance at the Bankers.

W. B. KEEN & CO., *Chartered Accountants.*

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# PART I: GENERAL PROCEEDINGS

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# PART I: GENERAL PROCEEDINGS

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Reconstitution postponed until the Nineteenth Session.

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<i>Name</i>	<i>Delegate of</i>
Badoux, Heli Société nationale de Recherche et d'Exploitation des Pétroles en Algérie, 35 boulevard Saint-Saens, Alger.	Société nationale de Recherche et d'Exploitation des Pétroles en Algérie.
de Beauregard, T. Service des Mines, 14 boulevard Baudin, Alger.	Service de la Carte géologique de l'Algérie.
Bétier, G. A. Service des Mines, 14 boulevard Baudin, Alger.	Government of Algeria; Service de la Carte géologique de l'Algérie.
Choubersky, André c/o Consulat général de Grande Bretagne, 26 boulevard Carnot, Alger.	
Dalloni, Marius Faculté des Sciences, Alger.	Université d'Alger; Service de la Carte géologique de l'Algérie.
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Petersen, Cristian S. Cordoba 260, Villa Ballester, Buenos Aires.	Dirección de Minas y Geología.
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*Fairbridge, Rhodes W. Department of Geology, University of Western Australia, Nedlands.	

# PART I : GENERAL PROCEEDINGS

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*de Jersey, N. J. Fuel Technology Department, Imperial College of Science and Technology, South Kensington, London, S.W.7.	
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Sprigg, Reginald Claude Geological Survey of South Australia, Department of Mines, 31 Flinders Street, Adelaide, South Australia.	Government of South Australia.
*Sprigg, Mrs. R. C. c/o Department of Mines and Geological Survey, 31 Flinders Street, Adelaide, South Australia.	
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*University of Melbourne Library Melbourne, Victoria.	
AUSTRIA	
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*Grove, Brandon H. Vacuum Oil Company A.G., Schwarzenberg-platz 5, Wien I.	
Metz, Karl Geological Institute, The University, Graz.	Government of Austria; Ministry of Education.
*Sander, Bruno Alte Universität, Universitätstrasse 4, Innsbruck.	(Österreichische Akademie der Wissenschaften.)
Schwarzacher, Walther Mineralogisches Institut, Universitätstrasse 4, Innsbruck.	
*Schwinnner, Robert Schillerstrasse 1, Graz.	
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Mason, B. H. Department of Geology, Indiana University, Bloomington, Indiana.	Indiana University; Royal Society of New Zealand (Canterbury Branch); Canterbury Museum.
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*Richards, J. T. P.O. Box 1557, Oklahoma City, Oklahoma.	
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| Russell, R. Dana<br>U.S. Navy Electronics Laboratory, San Diego 52, California.   | Society of Economic Paleontologists and Mineralogists.                              |
| Russell, Richard Joel<br>Louisiana State University, Baton Rouge 3, Louisiana.  | National Research Council; Louisiana State University.                              |
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| Sampson, Edward<br>Department of Geology, Princeton University, Princeton, New Jersey.                                    | Princeton University.   |
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- Bell, Miss W. A., Canada.
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- Belliére, J., Belgium.
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## Alphabetical List of Members from Overseas—continued.

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- \*Denaeyer, Mrs., Belgium.
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- Faris, M. I., Egypt.
- Farrington, A., Eire.
- Farrington, J. L., Nigeria.
- Favre, B., France.
- \*Fedorov, S. F., Union of Soviet Socialist Republics.
- \*Fedorov, V. F., Union of Soviet Socialist Republics.
- \*Felts, W. M., United States.
- \*Ferreira, A. B., (deceased), Portugal.
- Ferro, Miss H., Italy.
- Feruglio, E., Argentina.
- \*Fiala, F., Czechoslovakia.
- Field, R. M., United States.
- Fisher, N. H., Australia.
- Flagler, C. W., Denmark.
- Flandrin, J., Algeria.
- Fleming, C. A., New Zealand.
- \*Flint, R. F., United States.
- \*Florschütz, F., Netherlands.
- Flores, T., Mexico.
- \*Földvári, A., Hungary.
- Ford, R. D., United States.
- Fourmarier, P. F. J., Belgium.
- Fowler, W., Lebanon.
- \*Francis-Boeuf, C., France.
- Frei, A., Switzerland.
- Friant, Miss M., France.
- Friedlaender, C. G. I., Switzerland.
- Fromaget, J., France.
- Frost, A., South Africa.
- Frost, J., Trinidad.
- Fryxell, F. M., United States.
- Fuller, J. O., United States.
- Fuller, Mrs. M. C., United States.
- Gagnebin, E., Switzerland.
- \*Eby, J. B., United States.
- von Eckermann, H., Sweden.



# PART I : GENERAL PROCEEDINGS

## Alphabetical List of Members from Overseas—*continued.*

- Gajaseni, N. P., Siam.  
 Gallitelli, Mrs. E. M., Italy.  
 Gallitelli, P., Italy.  
 \*Gamburtsev, G. A., Union of Soviet Socialist Republics.  
 Gamper, Miss M., Switzerland.  
 Ganju, P. N., India.  
 \*Ganz, E., Kenya.  
 Ganz, W. J. C., Switzerland.  
 \*Gapeev, A. A., Union of Soviet Socialist Republics.  
 \*Gardner, G., Canada.  
 Garnett, P. F., Eire.  
 Gautier, M., Algeria.  
 \*Gavrilov, A. A., Union of Soviet Socialist Republics.  
 Geijer, P. A., Sweden.  
 \*Gekker, R. F., Union of Soviet Socialist Republics.  
 \*Geographical Institute of the University of Utrecht, Netherlands.  
 \*Geological Institute of Roumania, Roumania.  
 \*Geological, Mining and Metallurgical Society of India, India.  
 \*Geological Society of America, United States.  
 \*Geological Society of Portugal, Portugal.  
 \*Geological Survey of British Guiana, British Guiana.  
 \*Geological Survey of Poland, Poland.  
 \*Geological Survey of Portugal, Portugal.  
 Geukens, F., Belgium.  
 Gevers, T. W., South Africa.  
 Gharpure, B. V., India.  
 \*Ghika-Budesti, S., Roumania.  
 \*Gibson, R., United States.  
 Gill, J. E., Canada.  
 Gillet, Miss S. M., France.  
 \*Gilluly, J., United States.  
 Gindy, A. R., Egypt.  
 \*Giot, P. R., France.  
 Glangeaud, L., France.  
 \*Gluckman, B., South Africa.  
 \*Goetel, W., Poland.  
 Goguel, J., France.  
 \*Goldman, M. I., United States.  
 Goldsztaub, J., France.  
 \*Gorsky, J. J., Union of Soviet Socialist Republics.  
 Gortani, M., Italy.  
 \*Goryunov, S. V., Union of Soviet Socialist Republics.  
 Gottis, M., France.  
 Götzinger, G., Austria.  
 Grabham, G. W., Madeira.  
 Gray, K. W., New Guinea.  
 Greant, G. C. F., Algeria.  
 Gregory, H. E., United States.  
 Gregory, Mrs. H. E., United States.  
 Gregory, J. T., United States.  
 \*Griffiths, J. C., United States.  
 \*Griffitts, W. R., United States.  
 \*Grigorev, I. F., Union of Soviet Socialist Republics.  
 \*Grigoriev, J., Union of Soviet Socialist Republics.  
 Grim, R. E., United States.  
 Grip, E., Sweden.  
 \*Grishin, G. L., Union of Soviet Socialist Republics.  
 \*Gromov, V. I., Union of Soviet Socialist Republics.  
 Grosjean, A., Belgium.  
 Grout, F. F., United States.  
 \*Grove, B. H., Austria.  
 \*Gry, H., Denmark.  
 Gubbins, R. E., Egypt.  
 Gubler, Mrs. Y., France.  
 Guigue, Miss S., Algeria.  
 Guillaume, L., France.  
 \*Gulf Oil Corporation (Geological Department), United States.  
 \*Gulf Oil Corporation (New York Production Division), United States.  
 \*Gullentops, F., Belgium.  
 Das Gupta, A. B., India.  
 \*Gysin, M., Switzerland.  
 Hacquaert, A., Belgium.  
 Hadding, A., Sweden.  
 Hagen, T., Switzerland.  
 Hall, T. C. F., Portugal.  
 Halse, G. W., Trinidad.  
 Hansen, K., Denmark.  
 Hansen, S., Denmark.  
 Hanson, G., Canada.  
 Happel, L., Germany.  
 Harbison, Miss A., United States.  
 Harder, E. C., Canada.  
 \*Harkin, D. A., Tanganyika.  
 \*Harpum, J. R., Tanganyika.  
 Harrington, H. J., Argentina.  
 Haughton, S. H., South Africa.  
 Haughton, Mrs. S. H., South Africa.  
 Hawkes, H. E., United States.  
 \*Hawkins, J. E., United States.  
 \*Haworth, A. J., United States.  
 \*Hayes, A. O., United States.  
 Heater, W. E., United States.  
 Hedberg, H. D., United States.  
 Hede, J. E., Sweden.  
 Heermann, O., Germany.  
 van der Heide, S., Netherlands.  
 Heim, A., Switzerland.  
 \*Heimberg, G., Germany.  
 \*Hemmings, H., Netherlands.  
 Henderson, J. F., Canada.  
 Henin, S., France.  
 Henningsmoen, G., Norway.  
 Henquet, R., United States.  
 Heron, A. M., India.  
 \*Hickok, W. O., United States.  
 \*Higgins, J. W., United States.  
 Hindermeyer, J. G., Morocco.  
 Hla, T., Burma.  
 \*Hobbs, W. H., United States.  
 Hocart, R., France.  
 Hol, Mrs. J. B. L., Netherlands.  
 Holmes, R. J., United States.



# LIST OF MEMBERS

## Alphabetical List of Members from Overseas—*continued.*

- Holt, E. L., United States.  
Holtedahl, H., Norway.  
Holtedahl, O., Norway.  
\*Holtzwasser, Miss F., United States.  
Homayounfar, E., Iran.  
Hopkins, P. E., Canada.  
Hörner, N. G., Sweden.  
Hosking, J. S., Australia.  
Hottinger, A. F., Switzerland.  
Hourcq, V., France.  
Howell, B. F., United States.  
Howse, C. K., Newfoundland.  
\*Hsia, S. Y., China.  
\*Hua, F. T., China.  
Huang, T. K., China.  
\*Huffmann, C. R., United States.  
\*Humble Oil and Refining Company (Exploration Department), United States.  
Hurst, M. E., Canada.  
Huttenlocher, H., Switzerland.  
  
Ibrahim, M. M., Egypt.  
\*Illinois State Geological Survey, United States.  
Imperial, J. F., Philippines.  
\*Institute of Geology, Masaryk University, Czechoslovakia.  
\*Institut géologique, Université catholique de Louvain, Belgium.  
\*Institut scientifique chérifien, Morocco.  
\*Ion, D. C., Iran.  
Ippolito, F., Italy.  
\*Iskander, F., Egypt.  
\*Ismagilov, N. S., Union of Soviet Socialist Republics.  
Iyengar, B. V., India.  
Iyengar, S. V. P., India.  
  
Jablonski, E., United States.  
\*Jacob, C., France.  
Jacobson, R. R. E., Nigeria.  
Jacquemont, P., Morocco.  
\*Jaffé, R., Switzerland.  
Jagannathan, C. R., India.  
James, W. F., Canada.  
Jamotte, A., Belgium.  
\*Janczewski, E., Poland.  
Jarvik, E., Sweden.  
\*Jaskó, A., Hungary.  
\*Jeffreys, G., United States.  
Jérémime, Mrs. E., France.  
\*de Jersey, N. J., Australia.  
Jespersen, Miss A., United States.  
\*Jillson, W. R., United States.  
Johnson, J. H., United States.  
Johnson, W. M., India.  
Johnston, W. D., Jr., United States.  
Jolliffe, A. W., Canada.  
Jones, I. W., Canada.  
Jongmans, W. J., Netherlands.  
\*Joukowsky, E., Switzerland.  
  
\*Jozsef Nador Technical University, Hungary.  
de Juana, C. G., Venezuela.  
\*Jugovics, L., Hungary.  
\*Jurado, M. D., Argentina.  
  
\*Kacharava, I. V., Union of Soviet Socialist Republics.  
\*Kalapesi, A. S., India.  
Kamen-Kaye, M., Venezuela.  
\*Kamenskii, G. N., Union of Soviet Socialist Republics.  
Kashin, S. A., Union of Soviet Socialist Republics.  
\*Kassin, N. G., Union of Soviet Socialist Republics.  
\*Kay, F. R., Venezuela.  
Kay, M., United States.  
Kaye, C. A., United States.  
Kegel, W., Germany.  
Kehrer, L., Venezuela.  
\*Kehrer, W., Germany.  
Keller, Mrs. A. B., United States.  
Kent, L. E., South Africa.  
\*Kettner, R., Czechoslovakia.  
Kew, W. S. W., United States.  
Khan, M. F. H., Pakistan.  
Khan, M. H., Pakistan.  
\*Khelkvist, G. A., Union of Soviet Socialist Republics.  
Kierstead, F. H., United States.  
Kierstead, Mrs. F. H., United States.  
King, B. C., Nigeria.  
\*Kinghorn, H. J., (deceased), Germany.  
Kingma, J. T., Netherlands.  
Kingsley, Miss L., United States.  
Kjartansson, G., Iceland.  
\*Kobelyatskii, I. A., Union of Soviet Socialist Republics.  
von Koenigswald, G. H. R., Netherlands.  
Korn, Miss C., Germany.  
\*Korshunov, K. P., Union of Soviet Socialist Republics.  
Korzhinsky, D. S., Union of Soviet Socialist Republics.  
\*Koslov, M. F., Union of Soviet Socialist Republics.  
\*Kotlov, F. V., Union of Soviet Socialist Republics.  
Koutek, J., Czechoslovakia.  
Kozlowski, R., Poland.  
Kraus, P. S., Netherlands.  
\*Kreiter, V. M., Union of Soviet Socialist Republics.  
\*Krishnan, M. S., India.  
\*Krishtafovich, A. N., Union of Soviet Socialist Republics.  
\*Krotov, B. P., Union of Soviet Socialist Republics.  
\*Kudryavtsev, A. N., Union of Soviet Socialist Republics.  
Kuenen, P. H., Netherlands.  
Kugler, H. G., Trinidad.  
\*Kusmenko, V. I., Union of Soviet Socialist Republics.  
Kutina, J., Czechoslovakia.  
\*Kuznetsov, I. A., Union of Soviet Socialist Republics.  
\*Kuzniar, C., Poland.  
  
\*Laboratoire de Géologie appliquée de la Faculté des Sciences de Paris, France.  
\*Laboratoire de Géologie de l'Ecole normale supérieure, France.

# PART I: GENERAL PROCEEDINGS

## Alphabetical List of Members from Overseas—*continued*.

- Laffitte, R., Algeria.  
 Lagaaij, R., Netherlands.  
 \*Lahn, E., Turkey.  
 Lamego, A. R., Brazil.  
 Landmark, K., Norway.  
 Lane, E. S., Portugal.  
 \*de Lapparent, A. F., France.  
 Larsen, E. S., Jr., United States.  
 Larsen, Mrs. E. S., United States.  
 Laverdière, J. W., Canada.  
 \*Law, J., Iran.  
 Leakey, L. S. B., Kenya.  
 \*Lebedev, P. I., Union of Soviet Socialist Republics.  
 van Leckwyck, W. P., Belgium.  
 Leclercq, Miss S., Belgium.  
 Lecompte, M., Belgium.  
 \*Lee, C. Y., China.  
 Lee, J. S., China.  
 Legoux, P. C. A., France.  
 Legrand, R., Belgium.  
 Legraye, M., Belgium.  
 Lehner, E., Switzerland.  
 \*Leidhold, C., Argentina.  
 Lemmon, D. M., United States.  
 Lenoble, A., France.  
 \*Lepersonne, J., Belgium.  
 \*Leriche, M., Belgium.  
 Letort, Y., France.  
 Letourneur, J., France.  
 Leupold, W., Switzerland.  
 \*Levitskii, O. D., Union of Soviet Socialist Republics.  
 Lévy, R. G., Morocco.  
 \*Library, American Museum of Natural History,  
 United States.  
 van der Linden, E. J. P., United States.  
 \*Little, Miss J. de V., South Africa.  
 Little, O. H., Egypt.  
 de Lizáur y Roldan, J., Spain.  
 \*Lloyd, S. J., United States.  
 de Loczy, L., Turkey.  
 de Loczy, Mrs. M., Turkey.  
 \*Logathev, A. A., Union of Soviet Socialist Republics.  
 Lombard, A. E., Belgium.  
 \*Louisiana State University Library, United States.  
 Low, I. C., Iran.  
 \*Luchitskii, V. I., Union of Soviet Socialist Republics.  
 \*Lugeon, M., Switzerland.  
 \*Lukha, A. K., Union of Soviet Socialist Republics.  
 Lundblad, Miss B., Sweden.  
 Lupander, K., Finland.  
 Lutaud, L., France.  
 \*Lykiardopoulou, N. A., Belgium.  
 Lys, M., France.  
 Ma, H. Y., China.  
 Macar, P., Belgium.  
 McCallien, W. J., Turkey.  
 McCann, W. S., Canada.  
 McConnell, R. B., Tanganyika.  
 McGinty, J., Iraq.  
 Macgregor, A. M., Rhodesia.  
 McIntyre, D. B., Switzerland.  
 \*McKinlay, A. C. M., Tanganyika.  
 \*McLaren, D. J., Canada.  
 \*MacMillan, Mrs. V. R., Canada.  
 \*Magaktyan, I. G., Union of Soviet Socialist Republics.  
 \*Magistretti, C., Italy.  
 de Magnée, I., Belgium.  
 Magnusson, N. H., Sweden.  
 Maillard, P., France.  
 \*Le Maître, Miss D., France.  
 Marble, J. P., United States.  
 Marçais, J., Morocco.  
 Maréchal, R., Belgium.  
 \*de Margerie, E., France.  
 Marinos, G., Greece.  
 \*Markitanov, M. F., Union of Soviet Socialist Republics.  
 Marlière, R., Belgium.  
 Marlière-Lesoin, Mrs. Y., Belgium.  
 \*Marsden, E., New Zealand.  
 Marshall, P., New Zealand.  
 \*Martin, G. P. R., Germany.  
 \*Martin, M., France.  
 Martin, R., Netherlands.  
 Mason, B. H., United States.  
 Van Massenhove, H. E., France.  
 \*Massip, S., Cuba.  
 \*Mastropietro, G., Italy.  
 Mather, K. F., United States.  
 Mathias, Mrs. M., South Africa.  
 Mathieu, J. L., France.  
 \*Matveev, A. K., Union of Soviet Socialist Republics.  
 Maubeuge, P. L., France.  
 Maugis, P., France.  
 \*Mauritz, B., Hungary.  
 \*Maync, W., Switzerland.  
 \*Mayne, S. J., Kenya.  
 \*Mazarovich, A. N., Union of Soviet Socialist Republics.  
 Mazurczak, L., Colombia.  
 \*Méhes, C., Hungary.  
 \*Meier, O., Sweden.  
 \*Meinzer, O. E., (deceased), United States.  
 \*Melkov, V. G., Union of Soviet Socialist Republics.  
 Menchikoff, N., France.  
 Merla, G., Italy.  
 de Mestre, R. E., Burma.  
 Metre, W. B., India.  
 Metz, K., Austria.  
 Metzger, A., Finland.  
 Michel, P., France.  
 Michot, P., Belgium.  
 Migaux, L., France.  
 Migliorini, C. I., Italy.  
 \*Miholic, S., Yugoslavia.  
 \*Milon, Y., France.  
 Milthers, K., Denmark.  
 \*Mineralogical Institute, University of Stockholm,  
 Sweden.

# LIST OF MEMBERS

## Alphabetical List of Members from Overseas—*continued*.

- \*Mineralogical Institute, Masaryk University,  
Czechoslovakia.
- \*Mirchink, M. F., Union of Soviet Socialist Republics.
- \*Mirlin, G. A., Union of Soviet Socialist Republics.
- \*Mironov, S. I., Union of Soviet Socialist Republics.
- \*Modin, J., Union of Soviet Socialist Republics.
- \*Molchanov, I. I., Union of Soviet Socialist Republics.
- Moll, S., Jr., Philippines.
- Monod, T., French West Africa.
- Montandon, F., Switzerland.
- Moody, C. L., United States.
- Moody, J. D., Saudi Arabia.
- Moore, R. C., United States.
- von Moos, A., Switzerland.
- \*Morange, A., France.
- \*Moret, L., France.
- \*Morgante, S., Italy.
- Morin, L. G., Canada.
- Mortelmans, G., Belgium.
- Mountain, E. D., South Africa.
- \*Mount Holyoke College, United States.
- \*Mouta, F., Portugal.
- Movius, H. L., Jr., United States.
- \*Moyd, L., Canada.
- Murdoch, J., United States.
- \*Murgeanu, G., Roumania.
- Murthy, M. V. N., India.
- \*Muthuswami, T. N., India.
- Myint, K., Burma.
- Nakkady, S. E., Egypt.
- \*Nalivkin, D. S., Union of Soviet Socialist Republics.
- \*National Research Council of the U.S.A.,  
United States.
- \*Nechaev, L. A., Union of Soviet Socialist Republics.
- Negi, B. S., India.
- Neiva, J. M. C., Portugal.
- Nel, L. T., South Africa.
- Nel, Mrs. L. T., South Africa.
- Neltner, L., France.
- Neumann, H., Norway.
- Neuschel, S. K., Japan.
- Nevill, W. E., Eire.
- \*Nicklès, M., French Equatorial Africa.
- Nicolas, J., Tunisia.
- \*Nicolesco, C. P., France.
- Nieuwenkamp, W., Netherlands.
- Niggli, E., Netherlands.
- Niggli, P., Switzerland.
- \*Nikolaev, V. A., Union of Soviet Socialist Republics.
- Noe-Nygaard, A., Denmark.
- \*Nogara, J. A., Italy.
- Norin, E., Sweden.
- \*Norin, R. B., Sweden.
- Norvang, A., Denmark.
- Obermuller, A., France.
- O'Brien, M. V., Eire.
- \*Obruchev, V. A., Union of Soviet Socialist Republics.
- O'Connell, C. S., Eire.
- \*O'Connell, D. T., United States.
- \*O'Donnell, H., Portugal.
- Ödum, H., Denmark.
- Officer, Miss H. V., United States.
- Oftedahl, C., Norway.
- \*Ohio State University, Department of Geology,  
United States.
- \*Oklahoma City Geological Society, United States.
- \*Oklahoma Geological Survey, United States.
- Ongley, M., New Zealand.
- Oosterbaan, A. M., Netherlands.
- \*Oppenheim, V., Colombia.
- Orcel, J., France.
- Orgeval, M., France.
- Oulianoff, N., Switzerland.
- Owodenko, B., Morocco.
- \*Paffengolts, K. N., Union of Soviet Socialist  
Republics.
- Pamir, H. N., Turkey.
- Pannekoek, A. J., Netherlands.
- Pantó, G., Hungary.
- Parent, J., Belgium.
- \*Park, C. F., Jr., United States.
- Parsons, E., Kenya.
- Pastiels, A., Belgium.
- Pastoriza, D. A., Dominican Republic.
- Paulo, K. L., Canada.
- Paver, G. L., South Africa.
- \*Payne, A. L., Venezuela.
- Peacock, M. A., Canada.
- Percival, F. G., India.
- Pérébaskine, V., France.
- Perruche, A., France.
- Petersen, C. S., Argentina.
- \*Petersson, S. G., Sweden.
- Peyer, B., Switzerland.
- \*Philippi, G. T., Netherlands.
- \*Dal Piaz, G., Italy.
- Pickering, T., South Africa.
- Pinchemel, P., France.
- Pinto e Penha, J. M. de A., Portugal.
- Pirlot, P., Belgium.
- Pocovi, A., Argentina.
- Pogrebitsky, E. O., Union of Soviet Socialist  
Republics.
- \*Poiré, Miss I. V., United States.
- \*Pokrovskii, D. I., Union of Soviet Socialist Republics.
- Polinard, E., Belgium.
- \*Polkanov, A. A., Union of Soviet Socialist Republics.
- Pollett, J. D., Sierra Leone.
- \*Pomona College Library, United States.
- Ponte, L., Venezuela.
- \*Popov, I. V., Union of Soviet Socialist Republics.
- \*von Post, L., Sweden.
- Postel, A. W., United States.
- Pough, F. H., United States.
- Poulsen, C., Denmark.



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## Alphabetical List of Members from Overseas—*continued.*

- Poussin, J. de la V., Tanganyika.  
 Pruvost, P. E., France.  
 Pu, L., China.  
 Pulfrey, W., Kenya.  
 \*Pustovalov, L. V., Union of Soviet Socialist Republics.  
 Pyron, Mrs. G. D., United States.
- Quennell, A. M., Transjordan.  
 Quensel, P., Sweden.  
 de Quervain, F., Switzerland.
- de Radzitzky d'Ostrowick, I., Belgium.  
 \*Raeburn, C., Nigeria.  
 Raggatt, H. G., Australia.  
 Raguin, E., France.  
 Rai, K., India.  
 Rajnath, India.  
 Rao, M. S., India.  
 Rao, P. V., India.  
 Rashed, A. M., Egypt.  
 \*Rauzer-Chernousova, D. M., Union of Soviet Socialist Republics.  
 Raven, T., Netherlands.  
 Ray, L. L., United States.  
 Ray, Mrs. L. L., United States.  
 Regnéll, G., Sweden.  
 Reid, V. O., South Africa.  
 \*Reinhold, T., Netherlands.  
 \*Rengarten, V. P., Union of Soviet Socialist Republics.  
 Renier, A., Belgium.  
 Renner, J., Hungary.  
 \*Revelle, R., United States.  
 \*Revelli, G., Italy.  
 Reyna, J. G., Mexico.  
 \*Riba, J. M., Spain.  
 \*Ribeiro, J. T. A., Portugal.  
 \*Ribera-Faig, J. M., Spain.  
 Rich, J. L., United States.  
 Richard, Miss M., Algeria.  
 Richards, G. A., Trinidad.  
 \*Richards, H. G., United States.  
 \*Richards, J. T., United States.  
 Ricour, J., France.  
 \*Ridge, J. D., United States.  
 van Riel, W. J., Netherlands.  
 \*Rios, J. M., Spain.  
 Ritsema, A. R., Netherlands.  
 Ritter, E. A., Netherlands.  
 Robaux, A., Morocco.  
 Robert, M., Belgium.  
 Rodgers, J., United States.  
 Roesli, F. J., Switzerland.  
 Roger, J., France.  
 \*Roil, A., Germany.  
 Rolland, C. A., Canada.  
 Ronchesne, P., Belgium.  
 \*Ronchetti, C. R., Italy.  
 Rooney, G. W., Canada.  
 Roques, M., France.
- de Roubaix, J., Belgium.  
 Roubault, M. E., France.  
 \*Roxo, M. G. de O., Brazil.  
 Royer, L., Algeria.  
 Rozhansky, I. D., Union of Soviet Socialist Republics.  
 \*de La Rüe, E. A., France.  
 \*Rüegg, W., Peru.  
 Ruellan, F., France.  
 Ruiz Elizondo, J., Mexico.  
 \*Runin, M. M., Union of Soviet Socialist Republics.  
 Runner, J. J., United States.  
 \*Rusakov, M. P., Union of Soviet Socialist Republics.  
 \*Rusanov, M. G., Union of Soviet Socialist Republics.  
 Russell, R. D., United States.  
 Russell, R. J., United States.  
 \*Russell, R. T., United States.  
 Rutsch, R. F., Switzerland.  
 Rutten, M. G., Netherlands.
- \*Saakyan, P. S., Union of Soviet Socialist Republics.  
 Sadashivaiah, M. S., India.  
 Saenz Garcia, C., Spain.  
 Saether, E., Norway.  
 Sahni, B., India.  
 Sainfeld, P., Tunisia.  
 de Saint-Seine, P., France.  
 \*Salisbury, G. P., United States.  
 de Sampaio, A. C., Portugal.  
 Sampson, E., United States.  
 Samsonowicz, J., Poland.  
 Sanchez Mesorada, S. H., Mexico.  
 \*Sander, B., Austria.  
 Sandréa, A., France.  
 dos Santos, J. G., Portugal.  
 Sarkar, S. N., India.  
 \*Satpaev, K. I., Union of Soviet Socialist Republics.  
 \*de la Sauce, W., Germany.  
 Sauer, W., Ecuador.  
 \*Saukov, A. A., Union of Soviet Socialist Republics.  
 \*Säve-Söderberg, G., (deceased), Sweden.  
 Sayer, M., Turkey.  
 Sayre, A. N., United States.  
 Schaetti, H., Switzerland.  
 \*Schatsky, N. S., Union of Soviet Socialist Republics.  
 \*Scheer, S., France.  
 \*Scheid, V. E., United States.  
 Schenck, H. G., Japan.  
 \*Scherbakov, D. I., Union of Soviet Socialist Republics.  
 \*Scherf, E., Hungary.  
 Schindewolf, O. H., Germany.  
 \*Schlumberger, M., France.  
 Schlumberger, R. A., France.  
 Schmassmann, H., Switzerland.  
 Schmedeman, O. C., United States.  
 Schmook, G., Jr., Belgium.  
 Schneegans, D., France.  
 \*Schroeder, J. W., Colombia.  
 Schuiling, H. J., Belgian Congo.  
 Schumacher, J. P., United States.



# LIST OF MEMBERS

## Alphabetical List of Members from Overseas—continued.

- Schürmann, H. M. E., Netherlands.
- Schwarzsacher, W., Austria.
- \*Schwinner, R., Austria.
- \*Science Service, United States.
- \*Scobnikov, M. L., Union of Soviet Socialist Republics.
- Scott, H. A., United States.
- \*Scrobow, S. A., Union of Soviet Socialist Republics.
- Selli, R., Italy.
- \*Selskii, V. A., Union of Soviet Socialist Republics.
- Senn, A., Switzerland.
- \*Service géologique du Congo belge et du Ruanda-Urundi Bureau de Léopoldville, Belgian Congo.
- \*Service géologique de Maroc, Morocco.
- \*Service géologique de Tunisie, Tunisia.
- \*Seydoux, R., France.
- \*Shabynin, L. I., Union of Soviet Socialist Republics.
- Shand, S. J., United States.
- \*Shantser, E. V., Union of Soviet Socialist Republics.
- \*Shaub, B. M., United States.
- El Shazly, E. M., Egypt.
- \*Shcherbakov, V. V., Union of Soviet Socialist Republics.
- \*Shelton, J. S., United States.
- \*Shevyakov, B. V., Union of Soviet Socialist Republics.
- Shimer, J. A., United States.
- Shukri, N. M., Egypt.
- Sibinga, G. L. S., Netherlands.
- van der Sijp, J. W. C. M., Netherlands.
- \*da Silva, D. R., Portugal.
- da Silva, J. M., Portugal.
- \*Simakov, A. N., Union of Soviet Socialist Republics.
- \*Simões, J. de M. de O., Portugal.
- Simonen, A., Finland.
- Simpson, A., Nigeria.
- Sifñeriz, J. G., Spain.
- Sinha, P., India.
- \*Siniagin, G. P., Union of Soviet Socialist Republics.
- Sirimanne, C. H. L., Ceylon.
- de Sitter, L. U., Netherlands.
- Skerl, A. F., Tanganyika.
- \*Slocum Library, Ohio Wesleyan University, United States.
- \*Smirnov, W. I., Union of Soviet Socialist Republics.
- Smith, J. E., Trinidad.
- \*Smith, L. L., United States.
- \*Smolyaninov, N. A., Union of Soviet Socialist Republics.
- \*Smulikowski, K., Poland.
- Smyth, L. B., Eire.
- \*Soares, J. M. P., Portugal.
- \*Sobral, J. M., Argentina.
- \*Société belge de Géologie, de Paléontologie et d'Hydrologie, Belgium.
- \*Société géologique de France, France.
- \*Solaini, L., Italy.
- \*Solé, L., Spain.
- Sonder, R. A., Switzerland.
- \*Sondhi, V. P., India.
- Sonneveld, J., Netherlands.
- Soper, E. K., United States.
- Sorgenfrei, T., Denmark.
- \*Sorotchinsky, C., Belgian Congo.
- \*Sosman, R. B., United States.
- \*South Dakota School of Mines and Technology, United States.
- \*Southern Methodist University, United States.
- \*de Souza, H. C. A., Brazil.
- Spencer, A. J., United States.
- Spencer, E., India.
- Sprigg, R. C., Australia.
- Sprigg, Mrs. R. C., Australia.
- Sreshthaputra, N. V., Siam.
- \*Stadnichenko, Miss M. M., United States.
- Stadnichenko, Miss T., United States.
- Stainbrook, M. A., United States.
- Stanley, G. A. V., New Guinea.
- \*State Geological Survey, Bratislava, Czechoslovakia.
- \*State University of Iowa Libraries, United States.
- \*Stauffer, C. R., United States.
- Steneström, S., Sweden.
- Stensiö, E., Sweden.
- \*Stenzel, H. B., United States.
- Stevens, L. C., Netherlands.
- \*Stevenson, R. E., United States.
- Stewart, Miss G. A., United States.
- Stobbe, Miss H. R., United States.
- Stöcklin, J., Switzerland.
- Størmer, L., Norway.
- Stout, T. M., United States.
- Van Straelen, V., Belgium.
- Van Straelen, Mrs. V., Belgium.
- \*Strakhov, N. M., Union of Soviet Socialist Republics.
- \*Straley, H. W., III, United States.
- Strand, T., Norway.
- \*Strausz, L., Hungary.
- Streckeisen, A., Switzerland.
- Stringer, K. V., India.
- Studer, J. P., Nigeria.
- \*Stupakov, S. A., Union of Soviet Socialist Republics.
- \*Sturgeon, M. T., United States.
- Su, L., China.
- Sujkowski, Z., Poland.
- Sulimirski, S. L., Poland.
- Sun, Y. C., China.
- \*Suter, H. H., Trinidad.
- Sutton, A. G. A., Trinidad.
- Swidzinski, H., Poland.
- \*Szalai, T., Hungary.
- Tainsh, H. R., Burma.
- Taltasse, P., Morocco.
- Tarabrin, E. A., Union of Soviet Socialist Republics.
- Taranger, P. L., Morocco.
- Tashiro, S., Japan.
- Tasman, C. E., Turkey.
- van Tassel, R., Belgium.
- Taverne, N. J. M., Netherlands.
- Tavernier, R., Belgium.
- Taylor, J. F. A., Peru.

# PART I : GENERAL PROCEEDINGS

## Alphabetical List of Members from Overseas—*continued*.

- Taylor, M. H., United States.
- \*Teixeira, C., Portugal.
- \*Tercier, J., Switzerland.
- Termier, H., Algeria.
- Termier, Mrs. H., Algeria.
- \*de Terra, H., United States.
- Tester, A. C., United States.
- \*Tetgaev, M. M., Union of Soviet Socialist Republics.
- \*Thadeu, D., Portugal.
- \*Thalmann, H. E., Venezuela.
- Thi, B., Burma.
- Thaidens, A. A., Netherlands.
- Thomas, A. N., Iran.
- Thomas, H. C., Trinidad.
- Thoreau, J., Belgium.
- \*Thoren, C. J., United States.
- Thorslund, P. A., Sweden.
- \*Timmerhans, A., Belgian Congo.
- Tiwari, B. P., India.
- \*Tokody, L., Hungary.
- \*Tolstoi, M. P., Union of Soviet Socialist Republics.
- \*Tomlinson, W. H., United States.
- de Torcy, F., France.
- \*Torres, A. S., Portugal.
- Toulmin, L. D., Jr., United States.
- \*Trask, P. D., United States.
- Troedsson, G., Sweden.
- \*Trofimuk, A. A., Union of Soviet Socialist Republics.
- Trooster, S. G., Netherlands.
- \*Trümpy, D., Colombia.
- Trümpy, E., Switzerland.
- Trümpy, R., Switzerland.
- Tryggvason, T., Iceland.
- Tschopp, H. J., Switzerland.
- \*Tullis, E. L., United States.
- \*Turnau-Morawska, Miss M., Poland.
- \*Tvalchrelidze, A. A., Union of Soviet Socialist Republics.
- Tyndale-Biscoe, R., S. Rhodesia.
- Ubaghs, G., Belgium.
- \*Ufficio Geológico, Roma, Italy.
- \*Uklonskii, A. S., Union of Soviet Socialist Republics.
- Ullah, A., Pakistan.
- Umbgrove, J. H. F., Netherlands.
- \*United States Geological Survey, United States.
- \*Université libre de Bruxelles, Belgium.
- \*University of Cincinnati, Department of Geology Library, United States.
- \*University of Idaho, United States.
- \*University of Illinois, Department of Geology, United States.
- \*University of Illinois Library, United States.
- \*University of Kansas, Department of Geology, United States.
- \*University of Manitoba Science Library, Canada.
- \*University of Melbourne Library, Australia.
- \*University of Texas Library, United States.
- Unsalaner, Miss C., Turkey.
- Usoni, L., Italy.
- \*Vadász, E., Hungary.
- Vähätalo, V., Finland.
- Varadan, V. K. S., India.
- Vardabasso, S., Italy.
- \*Vasiliev, V. G., Union of Soviet Socialist Republics.
- Vatan, A., France.
- Vecchia, O., Italy.
- Verriest, Miss A. M., Belgium.
- \*Vianna, A., Portugal.
- \*Vigh, G., Hungary.
- Vilaplana, F. R., Spain.
- \*Vissac, G. A., Canada.
- van der Vlerk, I. M., Netherlands.
- Vogt, Miss M. C., United States.
- Vogt, T., Norway.
- \*Volfson, F. I., Union of Soviet Socialist Republics.
- \*Vologdin, A. G., Union of Soviet Socialist Republics.
- \*Volosyuk, G. K., Union of Soviet Socialist Republics.
- \*Vonderschmitt, L., Switzerland.
- Vuagnat, M., Switzerland.
- van der Waals, L., Netherlands.
- de Waard, D., Netherlands.
- Wadia, D. N., India.
- Waern, B., Sweden.
- Wahl, W. A., Finland.
- Wallace, M. H., Morocco.
- Walter, A. J. P., Belgium.
- Walter, P., Switzerland.
- Wanless, H. R., United States.
- Warburg, Miss E., Sweden.
- Warren, Mrs. C. R., United States.
- Wasson, E. B., United States.
- Watson, R. L. A., Pakistan.
- Watt, J., Kenya.
- Way, H. J. R., Swaziland.
- Wayland, E. J., Bechuanaland.
- Weber, A., Switzerland.
- Weeks, L. G., United States.
- van Weelden, A., Netherlands.
- Wegmann, E., Switzerland.
- Weiss, H., Switzerland.
- \*Weiss, O., South Africa.
- de Weisse, J. G., Switzerland.
- Welles, S. P., United States.
- Wellings, F. E., Lebanon.
- Wellnitz, Miss A. M., United States.
- Wells, J. W., United States.
- \*Wentworth, C. K., United States.
- Westerveld, J., Netherlands.
- Wheeler, R. R., United States.
- White, G. W., United States.
- White, M. P., United States.
- \*Whitehead, R. C., Burma.
- Willard, B., United States.
- Williams, J. E., United States.
- \*Williams, J. S., United States.

## LIST OF MEMBERS

### Alphabetical List of Members from Overseas—*continued.*

- |   |  |
|---|--|
| <p>Wilson, Miss A. E., Canada.<br/>           Wilson, I. F., United States.<br/>           Wilson, J. T., Canada.<br/>           Wilson, L. R., United States.<br/>           Wilson, M. E., Canada.<br/>           Wilson, T. C., Venezuela.<br/>           Wilson, W. B., United States.<br/>           Winchell, H., United States.<br/>           Winkler, H. G. F., Germany.<br/>           De Witte, G., Belgium.<br/>           Woldstedt, P., Germany.<br/>           Wolfe, P. E., United States.<br/>           *Wright, F. J., United States.<br/>           Wyszynski, Z. S., Poland.</p> | <p>*Young, C. C., China.<br/>           *Young, R. O., Venezuela.<br/> <br/>           *Zaborovskii, A. I., Union of Soviet Socialist Republics.<br/>           *Zahálka, B., Czechoslovakia.<br/>           Zák, L., Czechoslovakia.<br/>           *Zakharov, E. E., Union of Soviet Socialist Republics.<br/>           Zapletal, K., Czechoslovakia.<br/>           Záruba, Q., Czechoslovakia.<br/>           *Zavaritsky, A. N., Union of Soviet Socialist Republics.<br/>           Zbyszewski, G., Portugal.<br/>           *Zhemchuzhnikov, Y. A., Union of Soviet Socialist Republics.<br/>           *Zhilyakov, A. A., Union of Soviet Socialist Republics.<br/>           *Zhizhchenko, B. P., Union of Soviet Socialist Republics.<br/> <br/>           *Zonneveld, J. I. S., Netherlands.<br/>           Zoubek, V., Czechoslovakia.<br/>           Zuffardi, P., Italy.<br/>           Zutshi, L., India.<br/>           *Zveryuga, A. A., Union of Soviet Socialist Republics.<br/>           *Zwierzycy, J., Poland.</p> |
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- \*Yakubov, A. A., Union of Soviet Socialist Republics.  
 Yastrebov, B., Union of Soviet Socialist Republics.  
 Yate, A. B., United States.  
 \*Yen, T. C., United States.  
 Ygberg, E. R., Sweden.  
 \*Yin, T. H., China.

## ALPHABETICAL LIST OF BRITISH MEMBERS

### (RESIDENT IN GREAT BRITAIN)

#### \*Non-attending members and institutional members.

- |   |  |
|---|--|
| <p>Adlington, B. G. F.<br/>           Kilbridge, St. John's Road, Buxton, Derbyshire.<br/>           Agrell, S. O.<br/>           Department of Geology, The University,<br/>           Manchester 13.<br/>           Allan, D. A. (delegate of Royal Scottish Museum)<br/>           Royal Scottish Museum, Edinburgh.<br/>           *Allan, J. K.<br/>           55 Cumnor Road, Sutton, Surrey.<br/>           Allen, P.<br/>           Sedgwick Museum, Cambridge.<br/>           Allen, R. D.<br/>           13 New Bridge Road, Port Talbot, Glamorganshire.<br/>           Allison, A.<br/>           Anglo-Iranian Oil Company Limited, Britannic<br/>           House, Finsbury Circus, London, E.C.2.<br/>           *Anderson, W.<br/>           Geological Survey, 33 Eskdale Terrace, Newcastle-<br/>           upon-Tyne 2.<br/>           *Anglo-Saxon Petroleum Company Limited,<br/>           St. Helen's Court, Leadenhall Street, London, E.C.3.<br/>           Arber, Miss M. A.<br/>           52 Huntingdon Road, Cambridge.<br/>           Archer, A. A.<br/>           11a Westrow Gardens, Ilford, Essex.<br/>           Arkell, W. J.<br/>           Hurstcote, Cumnor, Oxford.<br/>           Ashcroft, F. N. (delegate of Geological Society)<br/>           38 Melbury Court, Kensington, London, W.8.<br/>           Atkinson, R. G.<br/>           Bridge End, Dalston, near Carlisle, Cumberland.</p> | <p>Baadsgaard, P. H.<br/>           40 Devonshire Road, Harrow, Middlesex.<br/>           Baden-Powell, D. F. W.<br/>           Stone End, Hinksey Hill, Oxford.<br/>           Bailey, E. B. (delegate of Geological Society)<br/>           19 Greenhill Gardens, Edinburgh.<br/>           Bailey, G. L.<br/>           British Non-Ferrous Metals Research Association,<br/>           81-91 Euston Street, London, N.W.1.<br/>           Bairstow, L.<br/>           British Museum (Natural History); Cromwell Road,<br/>           London, S.W.7.<br/>           Baker, J. W.<br/>           34 Westbourne Road, Whitchurch, Cardiff.<br/>           Baker, W.<br/>           6 Barnfield, Urmston, Manchester.<br/>           Ball, H. W.<br/>           43 Wildfell Road, Acock's Green, Birmingham 27.<br/>           Bannister, F. A.<br/>           Department of Mineralogy, British Museum (Natural<br/>           History), Cromwell Road, London, S.W.7.<br/>           Barber, M. J.<br/>           85 Wardown Crescent, Luton, Bedfordshire.<br/>           Barnard, T.<br/>           Department of Geology, University College, Gower<br/>           Street, London, W.C.1.<br/>           Barrett, Miss M. A.<br/>           Chevin, St. Mary's Road, Leatherhead, Surrey.<br/>           Barron, R. S.<br/>           Skelwyth, West Lavington, Wiltshire.</p> |
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# PART I: GENERAL PROCEEDINGS

## Alphabetical List of British Members—*continued*.

- Bartindale, Miss W. M.  
16 Spencer Road, London, S.W.18.
- Bassett, D. A.  
41 Trallwm Road, Llwynhendy, Llanelly, Wales.
- Bate, Miss D. M. A.  
British Museum (Natural History), Cromwell Road,  
London, S.W.7.
- Bathurst, R. G. C.  
40 Elm Bank Gardens, London, S.W.13.
- Bauer, Miss G. M.  
387 Harbourne Road, Edgbaston, Birmingham 15.
- Beard, E. H.  
Mineral Resources Department, Imperial Institute,  
South Kensington, London, S.W.7.
- Beer, E. J.  
Redi, King's Aish, Paignton, Devonshire.
- \*Begg, J. L.  
3 Mansionhouse Road, Glasgow, E.2.
- Behrens, Miss E.  
60 Park Lane, London, W.1.
- Bell, A. G.  
34 Sherard Road, Eltham, London, S.E.9.
- Bell, J.  
Tampico, Bolton-le-Sands, Carnforth, Lancashire.
- Bell, R. J.  
6 Willersley Avenue, Sidcup, Kent.
- Bennett, W. H.  
60 Orchard Avenue, Shirley, Surrey.
- Bentley, P.  
22 Valognes Avenue, Walthamstow, London.
- Benzian, Miss B.  
Rothamsted Experimental Station, Harpenden,  
Hertfordshire.
- Bernal, J. D. (delegate of Chemical Society)  
Birkbeck College Research Laboratory, 21 Torrington  
Square, London, W.C.1.
- Betambeau, P. C.  
2a Haysleigh Gardens, Anerley, London, S.E.20.
- Biggar, Miss J. T. M.  
24 Belsize Crescent, London, N.W.3.
- Bisat, W. S.  
The Dene, Collingham, near Leeds, Yorkshire.
- Bisson, G.  
Geological Survey and Museum, Exhibition Road,  
South Kensington, London, S.W.7.
- Black, W. W. (delegate of University of Nottingham)  
Department of Geology, The University,  
Nottingham.
- Blundell, R. K.  
8 Market Street, Caerphilly, Glamorganshire.
- Blyth, F. G. H.  
Department of Geology, Imperial College of Science  
and Technology, South Kensington, London, S.W.7.
- de Boer, G.  
3 Aylesbury Grove, Willerby Road, Hull.
- Bolton, C. M. G.  
Overseas League, St. James's Street, London, S.W.1.
- \*Boswell, P. G. H.  
63 Antrim Mansions, Hampstead, London, N.W.3.
- Bottley, E. P.  
Messrs. Gregory, Bottley and Company, 30 Old  
Church Street, Chelsea, London, S.W.3.
- Bowen, D.  
1 New Square, Lincoln's Inn, London, W.C.2.
- Bowie, S. H. U.  
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South Kensington, London, S.W.7.
- Boyd, D.  
Department of Geology, The University,  
Glasgow, W.2.
- Brade-Birks, S. G.  
Wye College, Wye, near Ashford, Kent.
- Bradford, E. F.  
64 Bedford Court Mansions, Bedford Avenue,  
London, W.C.1.
- Bradley, J. E. S.  
Physics Research Department, King's College,  
Strand, London, W.C.2.
- Bradshaw, R.  
61 West Side, Wandsworth Common, London,  
S.W.18.
- Branson, J. M.  
Ivy Close, Englefield Green, Egham, Surrey.
- \*Branston, Miss A. L.  
41 Raeburn Place, Edinburgh 4.
- Braunfeld, O.  
Grosvenor House, 73 Queen's Drive, London, N.4.
- Bray, A. (delegate of Ministry of Education)  
10 Kent Way, Stafford.
- \*Bright, N. F. H.  
33 Well Street, West Kilbride, Ayrshire.
- Brindley, G. W.  
Department of Physics, The University, Leeds.
- Bromehead, C. E. N.  
Geological Survey and Museum, Exhibition Road,  
South Kensington, London, S.W.7.
- Brown, C. B. (delegate of Government of British Guiana  
and of Geological Survey of British Guiana)  
Rokeby, Oakhill Road, Sevenoaks, Kent.
- Brown, E. E. S. (delegate of Geologists' Association)  
22 Park Hill Road, Sidcup, Kent.
- Brown, H. J. W.  
70 Purley Park Road, Purley, Surrey.
- \*Brown, J. C.  
Annandale, St. Catherine's, Broxbourne, Hertford-  
shire.
- Bruckshaw, J. M.  
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South Kensington, London, S.W.7.
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South Kensington, London, S.W.7.
- Bull, A. J.  
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South Kensington, London, S.W.7.



# LIST OF MEMBERS

## Alphabetical List of British Members—*continued.*

- Bulman, O. M. B.  
Sedgwick Museum, Cambridge.
- \*Burges, C. T.  
Staines Preparatory School, Knowle Green, Staines, Middlesex.
- Burkitt, M. C. (delegate of Royal Anthropological Institute)  
Merton House, Grantchester, Cambridgeshire.
- \*Burnett, G. A.  
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- \*Burt, G. M.  
91 Ebury Bridge Road, London, S.W.1.
- Burton, A.  
Stenson, Cromer, Norfolk.
- Burton, A. N.  
14 The Pleasance, Putney, London, S.W.15.
- \*Busk, H. G.  
Gilpins, Boldre, Lymington, Hampshire.
- Butler, A. J.  
Geological Survey and Museum, Exhibition Road, South Kensington, London, S.W.7.
- Butler, Mrs. A. J.  
Trees, Bucknalls Lane, Garston, Watford, Hertfordshire.
- Butler, J. R.  
43 The Mall, Swindon, Wiltshire.
- Butler, R.  
Ganha, Beechcroft Road, Bushey, Hertfordshire.
- Calver, M. A.  
1a Union Road, Cambridge.
- Cameron, J.  
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- Campbell, R.  
Grant Institute of Geology, King's Buildings, West Mains Road, Edinburgh 9.
- Campbell, Miss E. M. J.  
Courtauld House, Byng Place, London, W.C.1.
- Capewell, J. G.  
Department of Geology, University College, Gower Street, London, W.C.1.
- \*Carbometals Limited  
7 Aquila Street, St. John's Wood, London, N.W.8.
- \*Carpenter, P.  
6 Marlborough Mansions, Buxton, Derbyshire.
- Carruthers, R. G.  
High Barn, Stocksfield-on-Tyne, Northumberland.
- Carter, D. J.  
Department of Geology, Imperial College of Science and Technology, South Kensington, London, S.W.7.
- \*Caunter, F. L.  
Commonwood, Looe, Cornwall.
- Challinor, J.  
Department of Geology, University College of Wales, Aberystwyth.
- Chapman, O. H.  
29 Cambria Avenue, Ellesmere, Shropshire.
- Charlesworth, J. K. (delegate of Queen's University, Belfast)  
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- Cherry, D. W.  
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- Chilton, L. V.  
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- Chubb, L. J.  
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British Museum (Natural History), Cromwell Road, London, S.W.7.
- Cohen, E.  
125a Greencroft Gardens, London, N.W.6.
- Collingwood, C.  
28 Chancetonbury Chase, Redhill, Surrey.
- Collins, R. S.  
Hill View, Vale of Health, London, N.W.3.
- Colville, R. A.  
2 Farmhouse Road, Streatham, London, S.W.16.
- Cook, A. H.  
Corpus Christi College, Cambridge.
- Coomber, S. E.  
Royal School of Mines, South Kensington, London, S.W.7.
- Capisarow, A. C.  
6 Milborne Grove, South Kensington, London, S.W.10.
- Corbet-Milward, G. H.  
Hotel Rembrandt, London, S.W.7.
- Cornish, R. T.  
Department of Geography, Birkbeck College, Bream's Buildings, London, E.C.4.
- Cornwall, I. W.  
10 Mays Court, Crooms Hill, Greenwich, London, S.E.10.
- Covill, F. C.  
Hartford, Macclesfield Road, Buxton, Derbyshire.
- Cox, A. H. (delegate of National Museum of Wales)  
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- Cox, Miss H. M.  
30 Haselmere Avenue, Hendon, London, N.W.4.
- Cox, L. R.  
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- \*Craddock, R.  
Claveresk, Durham Road, Bishop Auckland, Co. Durham.
- Craig, G. Y.  
Westerlee, Clober Road, Milngavie, Glasgow.
- Craig, Miss J. C. D.  
39 Westbourne Gardens, Glasgow, W.2.
- Craven, C. A. U.  
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PART I: GENERAL PROCEEDINGS  
 Alphabetical List of British Members—*continued*.

- Croft, W. N.  
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- Crompton, W.  
 Burmah Oil Company Limited, Britannic House, Finsbury Circus, London, E.C.2.
- Crookall, R.  
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- Crowther, Miss M. A.  
 107 Finchampstead Road, Wokingham, Berkshire.
- \*Curnow, P. W.  
 39 Corstorphine Road, Edinburgh.
- Currie, Miss E. D.  
 Department of Geology, The University, Glasgow, W.2.
- Curry, D.  
 50 Cuckoo Hill Road, Pinner, Middlesex.
- Curtis, M. L. K.  
 The Stock House, Berkeley, Gloucestershire.
- Czarlinska, Mrs. T. Z.  
 22 Bromefield Road, Stanmore, Middlesex.
- \*Dalton, A. C.  
 Eyam, via Sheffield.
- Davidson, C. F.  
 Geological Survey and Museum, Exhibition Road, South Kensington, London, S.W.7.
- Davies, A. M.  
 Arngrove, Station Road, Amersham, Buckinghamshire.
- Davies, G. M.  
 63 Beechwood Road, Sanderstead, Surrey.
- Davies, J. H.  
 Bronygraig, Pontardawe, Glamorganshire.
- Davies, L. M.  
 8 Garscube Terrace, Edinburgh 12.
- Davies, W.  
 217 Highcliffe Road, Sheffield 11.
- Davies, W. B. (delegate of South Wales Institute of Engineers)  
 2 St. Andrew's Place, Cardiff.
- Davis, A. G.  
 75 Croydon Road, Penge, London, S.E.20.
- Davison, A. H.  
 50 Wellington Place, Belfast.
- Dawkins, H. W.  
 The Orangery, Hampton-on-Thames, Middlesex.
- Day, F. H.  
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163 Hartfield Road, Wimbledon, London, S.W.19.
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23 Hobart Road, Cambridge.
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- Phillips, K. A.  
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- Pimm, G. B. R. (delegate of Institution of Structural Engineers)  
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- Pinfold, E. S.  
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Lancashire.
- Pirie, G. W.  
63 Redington Road, London, N.W.3.
- Pitcher, W. S.  
35 Chelverton Road, Putney, London, S.W.15.
- Pitcher, Mrs. W. S.  
35 Chelverton Road, Putney, London, S.W.15.
- Pitt, L. J.  
1 Lancaster Road, North Harrow, Middlesex.
- Platt, J. I.  
Ashworth, Caemelyn, Aberystwyth, Cardiganshire.
- Plummer, E. E.  
Bynamlwg, Glanogwr Road, Bridgend,  
Glamorganshire.
- Pocock, R. W.  
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South Kensington, London, S.W.7.
- Ponsford, D. R. A.  
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South Kensington, London, S.W.7.
- Prentice, J. E.  
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London, W.C.2.
- Priestley, R. E. (delegate of University of Birmingham)  
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c/o Geological Survey, Southpark,  
19 Grange Terrace, Edinburgh 9.
- Pugh, W. J. (delegate of University of Manchester)  
Department of Geology, The University,  
Manchester 13.
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- Quirk, R. N.  
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7 Millbank, London, S.W.1.
- Ramsbottom, W. H. C.  
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# LIST OF MEMBERS

## Alphabetical List of British Members—*continued.*

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Ranmoor House, Fulwood Road, Sheffield 10.
- Rayner, Miss D. H.  
Department of Geology, The University, Leeds 2.
- Read, H. H. (delegate of Imperial College of Science and Technology and of Royal Society)  
Imperial College of Science and Technology, South Kensington, London, S.W.7.
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81 Dereham Road, Barking, Essex.
- Reeley, R.  
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- Reynolds, Doris L.  
Grant Institute of Geology, King's Buildings, West Mains Road, Edinburgh 9.
- \*Reynolds, S. H.  
13 All Saints Road, Bristol 8.
- Richardson, Miss B. M.  
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Britannic House, Finsbury Circus, London, E.C.2.
- \*Richey, J. E.  
36 Mansionhouse Road, Edinburgh 9.
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- Rivett, W. H. E.  
Home Farm, Fetcham, Leatherhead, Surrey.
- Robbie, J. A.  
Geological Survey of Northern Ireland,  
20 College Gardens, Belfast.
- Robertson, E.  
94 Victoria Road, Dundee, Angus.
- Robertson, Mrs. E. T.  
Department of Botany, The University, Aberdeen.
- Robertson, T.  
Geological Survey,  
33 Eskdale Terrace, Newcastle-upon-Tyne 2.
- Robins, Miss O.  
31 Camberwell Church Street, London, S.E.5.
- Robinson, C. I.  
37 Dorset Road, London, S.W.19.
- Robson, D. A.  
Department of Geology, The University, Edgbaston, Birmingham 15.
- Robson, J. (delegate of Royal Geological Society of Cornwall)  
Hillcrest, Beacon Terrace, Camborne, Cornwall.
- Rollo, D.  
Pleasant Hill, King's Road, Berkhamsted, Hertfordshire.
- Rose, W. C. C.  
Ministry of Fuel and Power,  
7 Millbank, London, S.W.1.
- Rothenburg, N.  
37 Dought Street, Mecklenburgh Square, Bloomsbury, London, W.C.1.
- Rumbold, R.  
50 Coombe Road, Croydon, Surrey.
- Russ, W.  
Myrledene, 38 Love Lane, Pinner, Middlesex.
- Russell, A.  
Swallowfield Park, Swallowfield, near Reading, Berkshire.
- Russell, Mrs. M.  
Geological Survey and Museum, Exhibition Road, South Kensington, London, S.W.7.
- Sabine, P. A.  
Geological Survey and Museum, Exhibition Road, South Kensington, London, S.W.7.
- \*St. Joseph, J. K. S.  
Selwyn College, Cambridge.
- Sainty, J. E.  
The Hedges, Cromer Road, West Runton, Cromer, Norfolk.
- Sales, Miss R. M.  
52 Mahon Avenue, Rawmarsh, near Rotherham, Yorkshire.
- Sanderson, Miss J. H.  
14 Blackford Road, Edinburgh 9.
- Sandford, K. S.  
University Museum, Oxford.
- Schnellmann, G. A.  
Florence Mine, Egremont, Cumberland.
- Schofield, W.  
Newlands, Calthorpe Drive, Prestatyn, Flintshire.
- Scott, E. C.  
Trinidad Leaseholds Limited,  
Salisbury House, Finsbury Circus, London, E.C.2.
- Scrivenor, J. B.  
68 Chaucer Road, Bedford.
- Seager, A. F.  
94 Ranelagh Road, Ealing, London, W.5.
- Seal, K. E.  
49 Conduit Road, Bedford.
- Searle, D. L.  
27 Churchfield Road, West Acton, London, W.3.
- Sennet, R. H.  
58 FitzJames Avenue, London, W.14.
- Seton-Williams, Miss M. V.  
9 Elvaston Place, London, S.W.7.
- Sewell, L. G.  
Pine Ridge, Park Road, Buxton, Derbyshire.
- Seyler, C. A. (delegate of British Coal Utilisation Research Association)  
British Coal Utilisation Research Association,  
13 Grosvenor Gardens, London, S.W.1.
- Shackleton, R. M.  
The Jane Herdman Laboratory of Geology, The University, Liverpool.

# PART I : GENERAL PROCEEDINGS

## Alphabetical List of British Members—*continued*.

- Shaw, S. H.  
Manor House Hotel, Upper Richmond Road,  
London, S.W.15.
- Shelford, J. R.  
Stamford School, Stamford, Lincolnshire.
- Shirley, J.  
Department of Geology, King's College, Newcastle-upon-Tyne.
- Shotton, F. W. (delegate of University of Sheffield)  
Department of Geology, The University, St. George's  
Square, Sheffield 1.
- Simons, H. S.  
1 Orchard Drive, Blackheath, London, S.E.3.
- Simpson, B.  
Department of Geology, University College,  
Swansea.
- Simpson, J. B.  
New Consolidated Gold Fields Limited,  
49 Moorgate, London, E.C.2.
- Simpson, J. B.  
Geological Survey, Southpark,  
19 Grange Terrace, Edinburgh 9.
- Sims, L. G. C.  
36 Queen's Gate Terrace, London, S.W.7.
- Skiba, W.  
5 Murrayfield Road, Edinburgh 12.
- Smith, B. W.  
9 Tancred Road, London, N.4.
- Smith, G. F. H. (delegate of Council for the Preservation  
of Rural England)  
British Museum (Natural History), Cromwell Road,  
London, S.W.7.
- Smith, S.  
Department of Geology, The University, Bristol 8.
- Smith, W. C. (delegate of British Government and of  
British Museum—Natural History)  
British Museum (Natural History), Cromwell Road,  
London, S.W.7.
- Smith, W. E.  
43 St. John's Road, Slough, Buckinghamshire.
- Smout, A. H.  
10 Waldegrave Gardens, Twickenham, Middlesex.
- Spath, L. F.  
39 Philbeach Gardens, London, S.W.5.
- Spaull, V. H. V.  
Sycamore Cottage, Feering, Colchester, Essex.
- Speed, P. H.  
17 Thornhill Road, Rowditch, Derby.
- Spencer, H. E. P.  
The Museum, High Street, Ipswich, Suffolk.
- Spencer, L. J. (delegate of Mineralogical Society)  
111 Albert Bridge Road, London, S.W.11.
- Spiller, R. C.  
University Museum, Oxford.
- Stamp, L. D.  
London School of Economics, University of London,  
London, W.C.2.
- Standing, A. J.  
Cavarnie, Oakfield Road, Bridgwater, Somerset.
- Stanley-Jones, D.  
Buckshead, Townshend, Hayle, Cornwall.
- Stebbing, W. P. D.  
Fiveways, Upper Deal, Kent.
- Steers, J. A. (delegate of Royal Geographical Society)  
St. Catharine's College, Cambridge.
- Stephen, I.  
Pedology Department, Rothamsted Experimental  
Station, Harpenden, Hertfordshire.
- Stephens, E. A.  
Crewe Hall, Clarkehouse Road, Sheffield 10.
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South Road, Durham.
- Stock, S.  
4 Mirasol, Granville Road, Eastbourne, Sussex.
- \*Stopes, Marie C.  
Norbury Park, Dorking, Surrey.
- \*Storey, C. B. C.  
Plas Nantyr, Glen Ceiriog, Wrexham, Denbighshire.
- Strachan, I.  
4 Ann Street, Edinburgh 4.
- Straw, S. H. (delegate of Manchester Geological  
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Department of Geology, The University,  
Manchester 13.
- Strong, M. W.  
D'Arcy Exploration Company Limited,  
P.O. Box 1, Southwell, Nottinghamshire.
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South Kensington, London, S.W.7.
- Sweet, Miss J. M.  
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(Natural History), Cromwell Road, London, S.W.7.
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- Sweeting, Miss M. M.  
Newnham College, Cambridge.
- Swinton, W. E. (delegate of Linnean Society)  
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Department of Geology, The University, St. George's  
Square, Sheffield 1.
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South Kensington, London, S.W.7.
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# LIST OF MEMBERS

## Alphabetical List of British Members—continued.

- \*Taylor, L. F.  
H. J. Enthoven and Sons Limited,  
Darley Dale Works, South Darley, Matlock, Derbyshire.
- Teale, E. O. (delegate of Government of Tanganyika)  
Littlecroft, Pirbright, Woking, Surrey.
- Temperley, B. N.  
Department of Geology, The University, Bristol 8.
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15 Daleham Mews, London, N.W.3.
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- \*Thermal Syndicate Limited  
Wallsend, Northumberland.
- Thirlaway, H. I. S.  
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- \*Thomas, G. E.  
Bryn-Bach, Bettws, Bridgend, Glamorganshire.
- Thomas, G.  
Department of Geology, Imperial College of Science and Technology, South Kensington, London, S.W.7.
- Thomas, H. D.  
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- \*Thomas, H. H.  
Downing College, Cambridge.
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15 George Street, London, E.C.4.
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Stavros, West Hill, Epsom, Surrey.
- \*Tylden-Wright, H.  
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- Walters, R. C. S. (delegate of Institution of Water Engineers)  
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- Watson, Miss J. V.  
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- Watson, M.  
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- Weatherhead, T. D.  
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6 Elstree Way, Boreham Wood, Hertfordshire.
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29 Drayton Gardens, Winchmore Hill, London,  
N.21.
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Kensington, London, S.W.7.
- Webb, Miss M.  
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Kensington, London, S.W.7.
- \*Weir, J.  
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- Wells, A. K. (delegate of King's College, London)  
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- Whitaker, J. H. McD.  
21 Rathmore Road, Cambridge.
- White, Miss E.  
12 Ross Way, Eltham, London, S.E.9.
- White, Mrs. E. D. M.  
Hartstock, Great Missenden, Buckinghamshire.
- White, E. I.  
Department of Geology, British Museum (Natural  
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- Whittard, W. F. (delegate of University of Bristol)  
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- Whitten, E. H. T.  
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End Road, London, E.1.
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- Whitworth, T.  
Department of Geology, University Museum,  
Oxford.
- Wilcockson, W. H.  
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Square, Sheffield 1.
- Wilkinson, P.  
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Square, Sheffield 1.
- Willbourn, E. S. (delegate of Government of Federation  
of Malaya)  
Colonial Geological Surveys, Imperial Institute,  
South Kensington, London, S.W.7.
- Williams, D. (delegate of Geological Society)  
Department of Geology, Imperial College of Science  
and Technology, South Kensington, London, S.W.7.
- Willis, Miss C.  
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- Willis, P. M. R.  
Crewe Hall, Clarkehouse Road, Sheffield 10.
- Wills, L. J. (delegate of University of Birmingham)  
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St. Clair, Doods Park Road, Reigate, Surrey.
- Wilson, Miss E. J.  
15 Hathaway Drive, Giffnock, Glasgow.
- Wilson, G.  
Department of Geology, Imperial College of Science  
and Technology, South Kensington, London, S.W.7.
- Wilson, V.  
Geological Survey and Museum, Exhibition Road,  
South Kensington, London, S.W.7.
- Wisden, Miss D. E. (delegate of University College,  
Southampton)  
Department of Geology, University College,  
Southampton.
- Wood, A.  
Department of Geology, University College of Wales,  
Aberystwyth.
- Wood, P. W. J.  
Home Farm House, Alvercot, Oxfordshire.
- Woodland, A. W.  
Geological Survey and Museum, Exhibition Road,  
South Kensington, London, S.W.7.
- Woodward, Lady M.  
Flat 3, 16 Sussex Square, Brighton 7, Sussex.



## LIST OF MEMBERS

### Alphabetical List of British Members—*continued*.

- |   |   |
|---|---|
| <p>Wooldridge, S. W.<br/>King's College, Strand, London, W.C.2.</p> <p>Wordie, J. M.<br/>St. John's College, Cambridge.</p> <p>Worssam, B. C. G.<br/>Geological Survey and Museum, Exhibition Road,<br/>South Kensington, London, S.W.7.</p> <p>Worthington, C. E.<br/>196 Palace Chambers, Bridge Street, London, S.W.1.</p> <p>Wright, C. W.<br/>9 Gloucester Walk, Kensington, London, W.8.</p> <p>*Wright, J.<br/>212 Colinton Road, Edinburgh.</p> | <p>Yeates, Miss R. N.<br/>81 Queen's Gate, London, S.W.7.</p> <p>Young, Miss M. C.<br/>63 Warwick Road, London, S.W.5.</p><br><p>Zeuner, F. E. (delegate of University of London Institute<br/>of Archaeology)<br/>Institute of Archaeology, Inner Circle, Regent's<br/>Park, London, N.W.1.</p> <p>Zubrzycki, P. P.<br/>5 Bellevue Terrace, Edinburgh.</p> |
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## LIST OF BRITISH INSTITUTIONS REPRESENTED BY DELEGATES

- |  |   |
|--|---|
| <p>British Association for the Advancement of Science<br/>British Coal Utilisation Research Association<br/>British Government</p><br><p>British Museum (Natural History)</p><br><p>Bristol City Museum<br/>Cambridge Philosophical Society<br/>Chemical Society</p><br><p>Colonial Office<br/>Council for the Preservation of Rural England<br/>Geological Society of London</p><br><p>Geological Society of Glasgow<br/>Geological Survey and Museum</p><br><p>Geologists' Association<br/>Glasgow Art Gallery and Museum<br/>Imperial College of Science and Technology<br/>Institute of Petroleum<br/>Institution of Civil Engineers<br/>Institution of Mining and Metallurgy</p><br><p>Institution of Mining Engineers<br/>Institution of Structural Engineers</p><br><p>Institution of Water Engineers<br/>Ipswich Corporation Museum<br/>King's College, University of London</p> | <p>A. E. Trueman<br/>Clarence A. Seyler<br/>W. F. P. McLintock<br/>W. Campbell Smith<br/>A. E. Trueman<br/>W. Campbell Smith<br/>W. N. Edwards<br/>F. S. Wallis<br/>O. T. Jones<br/>J. D. Bernal<br/>F. A. Paneth<br/>F. Dixey<br/>G. F. Herbert Smith<br/>F. N. Ashcroft<br/>E. B. Bailey<br/>Percy Evans<br/>Arthur Holmes<br/>O. T. Jones<br/>W. F. P. McLintock<br/>K. P. Oakley<br/>A. E. Trueman<br/>D. Williams<br/>A. T. J. Dollar<br/>W. F. P. McLintock<br/>T. Eastwood<br/>J. Phemister<br/>T. H. Whitehead<br/>E. E. S. Brown<br/>S. M. K. Henderson<br/>H. H. Read<br/>T. Dewhurst<br/>H. J. F. Gourley<br/>Lewis L. Fermor<br/>W. R. Jones<br/>H. G. A. Hickling<br/>G. B. R. Pimm<br/>Leslie Turner<br/>R. C. S. Walters<br/>G. Maynard<br/>W. T. Gordon<br/>A. K. Wells</p> |
|--|---|

# PART I: GENERAL PROCEEDINGS

## List of British Institutions Represented by Delegates—*continued.*

Linnean Society	W. E. Swinton
Liverpool Geological Society	A. Tindell Hopwood
Manchester Geological Association	R. K. Gresswell
Mineralogical Society	T. A. Jones
Ministry of Education	S. H. Straw
National Museum of Wales	G. F. Claringbull
Palaeontographical Society	L. J. Spencer
Queen's University, Belfast	Arthur Bray
Royal Anthropological Institute	W. J. Evans
Royal Geographical Society	A. H. Cox
Royal Geological Society of Cornwall	H. L. Hawkins
Royal Scottish Museum	C. J. Stubblefield
Royal Society	J. K. Charlesworth
Royal Society of Edinburgh	M. C. Burkitt
Society of Engineers (Incorporated)	A. Austin Miller
South Wales Institute of Engineers	J. A. Steers
University College, London	J. Robson
University College, Southampton	D. A. Allan
University of Aberdeen	H. H. Read
University of Birmingham	Arthur Holmes
University of Bristol	W. D. Haworth
University of Cambridge	F. J. North
University of Durham	W. Brynmor Davies
University of Edinburgh	S. E. Hollingworth
University of Glasgow	D. M. S. Watson
University of Leeds	Miss Dorothy E. Wisden
University of London	T. C. Phemister
University of London Institute of Archaeology	R. E. Priestley
University of Manchester	L. J. Wills
University of Nottingham	W. F. Whittard
University of Oxford	O. T. Jones
University of St. Andrews	W. B. R. King
University of Sheffield	C. E. Tilley
Yorkshire Geological Society	H. G. A. Hickling
	L. R. Wager
	Arthur Holmes
	T. Neville George
	G. W. Tyrrell
	W. Q. Kennedy
	W. T. Gordon
	F. E. Zeuner
	W. J. Pugh
	W. W. Black
	J. A. Douglas
	D. E. Innes
	F. W. Shotton
	H. C. Versey

## PROCEEDINGS OF THE GENERAL ASSEMBLY

First Meeting of the General Assembly, in the Royal Albert Hall, at 11 a.m.  
on Wednesday, August 25th, 1948

**P**ROFESSOR V. V. BELOUSOV, Head of the Delegation of the Union of Soviet Socialist Republics, was in the Chair.

Mr. A. J. Butler, General Secretary, introduced Professor Belousov:—

“My Lord, Sir John Anderson, Ladies and Gentlemen:

Academician A. N. Zavaritsky is unfortunately prevented by ill-health from being present here to-day.

We welcome, as Head of the Delegation of the Union of Soviet Socialist Republics, Professor V. V. Belousov. Professor Belousov, whom I now introduce to you, takes the Chair for the first part of this Meeting as the representative of the late President of the Seventeenth Session of the International Geological Congress which was held in Moscow in 1937.”

Professor Belousov then addressed the Assembly:—

“Ladies and Gentlemen,

As Academician A. N. Zavaritsky is absent owing to illness, which we all deeply regret, it has fallen to my lot to have the honour of announcing the opening of our work. Allow me on behalf of the Geological Institutions and geologists of the Soviet Union to convey to you my most cordial greetings.

Eleven years have elapsed since the last Geological Congress was held in Moscow, and within this time the world has been shattered by the appalling events of the war which brought about most tremendous destruction and interrupted the normal course of scientific work. During the long interval since the last Geological Congress, Geological Science has suffered many heavy losses. We deeply regret the death of the President of the Seventeenth Session of the Congress, I. M. Gubkin, who, according to tradition, was to have opened this Session. We also deplore the loss of both Presidents of the General Organizing Committee, Sir William Bragg and Sir Thomas Holland, who had done so much to ensure the successful organization of the present Congress. Many geologists fell victims of the last disastrous war.

Assuming my duty of representing the late President of the Seventeenth Congress, I must first of all express my profound confidence in the common feeling inspiring all the members of the Congress and corresponding to the feelings of all progressive people throughout the world that in the future mankind should never again experience the terrors of war, that interrupt and handicap the peaceful progress and development of Science.

Further, I wish to express my gratitude to the Organizing Committee and to our British colleagues for the excellent organization of the Congress and for the instructive excursions in the course of which we have had an opportunity to acquaint ourselves with the geology of this very interesting country. There can be no doubt whatever about the success of this Session of the Congress at which such eminent scholars of geological science are represented.

I declare the Eighteenth Session of the International Congress open.”

At the request of the Chairman, Mr. A. J. Butler, General Secretary, then read proposals for the President, Bureau and Council of the Eighteenth Session, as agreed by a Preliminary Meeting of the Council held on the evening of August 24th. The Chairman asked the Assembly to approve the proposals by acclamation.

The Chairman declared the proposals to be carried, and invited Professor H. H. Read, the President of the Eighteenth Session, to assume the Chair.

Professor Read took the Chair, and addressed the Assembly:—

“Members of the General Assembly of the Eighteenth Session of the International Geological Congress, I offer to you my personal thanks for the great honour you have done me in electing me President of this Congress. But I have also to thank you in another capacity—as President of the Geological Society of London, the body that has invited you to meet here in London. On its behalf, I thank you for accepting our invitation and for coming here in such great numbers, often in the face of considerable difficulties.

During the organization of this Session over the last few years, we have had many anxious moments concerning the fate of our meeting. In the early period of our labours, we were sustained by the vision and enthusiasm of the late Sir Thomas Holland, whose place I so inadequately fill. His faith is now seen to be completely justified. This Session is a record in numbers of participants, of excursionists and of contributors to the proceedings of the meetings here. To all of you, old friends, new friends and friends-to-be, I extend the heartiest of welcomes—you may rest assured that we have done everything possible to make your visit a pleasant one.

We are proud to welcome at our Assembly the Right Honourable Viscount Addison, Lord Privy Seal in His Majesty's Government. It is very fitting that His Lordship should be here not only because he holds high Government office, but also because he is a serious scientist with a distinguished record of scientific research. He is able, if he wishes, to address this Assembly as a scientist speaking to scientists and, truly, as a professor speaking to many professors. His Lordship's researches in their style bear a striking similitude to ours: his work in topographic anatomy involved a patient investigation of surface detail and its relation to deep structure that is essentially of the same pattern as the researches of geologists in their different field. We can be sure that he and we are of the same spirit.

I invite you, My Lord, to address this General Assembly on behalf of His Majesty's Government.”

The Right Honourable Viscount Addison:—

“Mr. President, Ladies and Gentlemen,

I am glad to have the honour and opportunity of extending, on behalf of His Majesty's Government, a hearty welcome to this Eighteenth Session of the International Geological Congress. When, two years ago, the Geological Society of London discussed the matter with the Government, we were pleased to assure the Society of our support in making arrangements for the Congress. The splendid response to their invitation, as evidenced by this large meeting, is good testimony of the efficiency of the arrangements which have been made.

It is regretted by us all that your meetings have been interrupted so long by war. I associate myself wholeheartedly with Professor Belousov in expressing sincere hope and trust that no such calamity will ever intervene again.

I am this morning acting as a *locum tenens*. As Leader of the House of Lords, I am taking the place of my colleague Mr. Herbert Morrison, Lord President of the Council, Leader of the House of Commons, and the Minister responsible for the administration of official scientific research in this country. The period of war has made Governments everywhere increase their demands upon men of science. As many who are present know, our Government to-day seeks in return to give increasing help to scientific research.

As geologists you have the whole earth as your subject. By comparison with the vast periods of geological time, the activities of the human race appear minute and transient; nevertheless for the progress of mankind your help is required more and more.

This is certainly the case in Great Britain. We have the advantage of a Geological Survey founded more than a hundred years ago. Many of you, on your excursions, have already seen a great deal of its work, and will during this Session see much more. But, in spite of all that has



already been done, the demand upon geologists for practical and economic work is still very great.

We have been digging coal in this country for hundreds of years; but a considerable scheme of further exploration of our coal resources which is now being undertaken by the Geological Survey may clearly be of great value. The work of the geologist is helpful to the engineer in all manner of directions; and we find proof of this, for example, in great saving effected as a result of geological advice in the location of the dams for electric power in the Scottish Highlands. Another problem which I know is engaging our geologists' attention is the survey and conservation of the water-supply of this great and expanding city of London, and of other large cities in Britain.

With regard to the exploration and development of mineral deposits, every country is making demands upon its geologists. And there is another field in which your aid is increasingly required, namely the examination and conservation of soils, their irrigation, and in fact the whole question of the influence of geology upon agriculture and the production of food. There is no country where the demands for knowledge in this respect are likely to increase more than in Africa. As you know, very great developments are being planned in different parts of that continent. If mankind is to have enough food in the coming years it is certainly necessary that these developments shall yield profitable results, and for this the guidance of expert geologists is essential.

Apart from all such practical matters, it is good that in a Congress such as this scientists from all over the world can meet and exchange views frankly. Here you will exchange notes, advise one another, get to know one another. Your meeting together must be a great stimulus to you all. You know, better than I do, the vastness of the field in which you work; but we all know that despite the diligence and research of past years there is still much to be discovered.

I think, however, that there is one thing above all others that emerges from a consideration of your agenda and must emerge from your deliberations—how ephemeral and small, in reality, are the things that divide the nations and the peoples, and how many are the things that may be of use to us all. Such Congresses as yours, therefore, should help to express the differences in their right and trivial proportions, and the consideration of the great and valuable things vital to all mankind should help to bind us more and more together."

The President:—

"My Lord, I thank you for your kind welcome and through you His Majesty's Government for the practical expression of that welcome that they have made in affording the countless facilities that will do much to make this Eighteenth Session a most memorable one.

I now have the pleasure of asking the Right Honourable Sir John Anderson, Honorary President of the General Organizing Committee, to address the Assembly. In Sir John we have again that combination of scientist and administrator so needful in these times. Because of this combination, we are grateful that he has been able, in spite of the press of affairs, to accept the office of Honorary President of the General Organizing Committee. Sir John has served his country in high offices at home and abroad. The great distinction of his service owes much, we feel, to his early training as a scientist and to his continued application of the scientific method and his appreciation of the scientific viewpoint throughout his administrative labours.

Sir John, I have the honour to invite you to address this Assembly on behalf of the General Organizing Committee."

The Right Honourable Sir John Anderson:—

"Mr. President, Ladies and Gentlemen,

The International Geological Congress to-day returns to Great Britain after an interval of almost exactly 60 years. It was in 1888 that the Fourth Session was held here with T. H. Huxley as its Honorary President and Joseph Prestwich as its President. I have great pleasure in offering, on behalf of the Geological Society of London and of the General Organizing Committee, a cordial welcome to this first General Assembly of the Eighteenth Session of the International Geological Congress.

The Sixteenth and Seventeenth Sessions of the Congress were most successfully organized in

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two other great capital cities—the Sixteenth Session in Washington and the Seventeenth in Moscow.

The organization of this present Session has had a long and troubled history. A preliminary suggestion by British geologists that the Congress should meet in this country was made to the Session in Washington in 1933. When the Congress met in Moscow four years later, the British delegation there, speaking in the name of the Geological Society of London, and having been assured of the approval and support of His Majesty's Government, was able to put forward a firm invitation that the Eighteenth Session should be held here in 1940. That invitation, to the great pleasure and satisfaction of all British geologists, was accepted by the Council and by the General Assembly in Moscow.

Arrangements for the organization of the Session began immediately. A large and widely representative General Organizing Committee charged with the general oversight of the preparations, and a smaller Executive Committee responsible for their detail were set up; and the late Sir Thomas Holland was elected as President-Designate of the General Organizing Committee and as Chairman of the Executive Committee.

During the next two years good progress was made in the work of organization. A preliminary list of subjects for discussion during the Session, and a provisional programme of geological excursions in this country, were prepared and communicated in 1938 to geologists in all countries. These lists were adjusted and expanded in the light of the comments received and more detailed plans were made known early in 1939. At that same time invitations to appoint official Delegates to the Congress were despatched to Governments, universities and geological institutions and societies throughout the world. The response was good, and arrangements were well in hand by the middle of the year.

The whole of the work had, however, been done under conditions of increasing political tension in Europe, and in September, 1939, on the outbreak of the Second World War, it was clear that it was impossible to continue. Organization was suspended, and the Session was indefinitely postponed.

In 1946, the Geological Society of London came to the conclusion that it was practicable to resume the work of organization. The British Government reaffirmed its approval and support for the project, and in October, 1946, it was agreed that the Session should take place in August of this present year. The Committees were reconstituted and new invitations were issued; and since that time the work leading to this Assembly to-day has been pressed forward without pause.

It is perhaps doubtful whether that decision to hold the Session this year would have been taken in 1946 had the full strength and duration of the national and international stresses and scarcities which have followed the war been foreseen. Because of the excursion programme which is a major part of the proceedings of a Session of this Congress, the country which is host has responsibilities and duties which do not arise in connection with the international congresses of most other sciences. It was hoped in 1946 that the situation in this country in 1948, as regards food supplies, accommodation and transport would be easier than it is in fact to-day. In addition, the persistence and indeed the aggravation of currency restrictions, of shipping difficulties and of other factors which still so gravely hinder any international assembly, were not fully measured. But we are glad to-day that the decision was taken; for, despite the many serious hindrances and obstacles, this present Assembly includes more than twice as many delegates and members from abroad as have attended any previous Session, and is also greater than any previous Assembly in its total attendance. This is in fact the largest single gathering of persons interested in the geological sciences which has ever taken place.

It is matter of grief to all who have been associated with the organization, that Sir Thomas Holland, first President-Designate of the Session, has not lived to preside here to-day; for not only were the plans of the organization drafted under his Chairmanship in the pre-war years, it was also due essentially to his personal initiative that the project was resumed in 1946. His death last year, before the fruition of the plans, was a great sadness and a great loss.



Sir Thomas is succeeded by Professor H. H. Read, the present President of the Geological Society of London, which is the inviting body and the main host of this Session; and I would like here to comment on the relation of that Society to the General Organizing Committee. The Geological Society of London is the premier society of geologists in this country. Its membership is large and diverse, and includes men engaged in study, research and practice in every field of geological knowledge. But because the holding here of a Session of the International Geological Congress is a matter of such rare occurrence and special importance, the Geological Society has taken care, by constituting the General Organizing Committee, to associate directly with the preparations for the Session a wider range of institutions and of interests.

Among these are the Royal Society, the Royal Society of Edinburgh and the British Association for the Advancement of Science—bodies whose activities embrace all branches of natural science. Universities and university colleges throughout the country are represented. There are representatives of the authorities of the City and the County of London; of the principal British learned societies which specialize in sciences allied to geology—anthropology, archæology, biology, geography and the physical sciences; of the several geological societies in Scotland and the English provinces; of our professional institutions of engineers; of our national and our provincial museums; and of industrial companies concerned with the extraction and the use of mineral deposits.

There are also represented Departments of Government concerned with geological, topographical and hydrographical surveying. The Lord Privy Seal has assured you of the interest of the British Government in this Session, and has mentioned the substantial part which Officers of the Geological Survey and Museum have played in its organization. I too would like to express warm appreciation of their contribution. They have worked without stint. Without their aid no part of the organization, either of the Sessional meetings or of the excursions in the field, could have been completed.

Lastly, I should like to record the important part which the amateur geologists of Britain have played, and to mention in particular the Geologists' Association, a thriving body in which amateur and professional geologists combine their forces, and which has contributed much to the work of organization.

This list is in no order of precedence, nor is it complete. But I trust that it may illustrate not only the broad basis of our organization, but also the widespread appreciation, among the scientists of Britain, of the honour which the Congress confers upon them by meeting here in London.

I turn now to a brief review of the programme of the Session, so far as concerns the scope of its formal meetings and discussions during the next seven days. The themes of the Sectional meetings of the Session are characterized by diversity and balance. Two Sections will discuss the fundamental chemistry of rocks and of minerals—the distribution of the common and rare elements within them, their prime origin, and their subsequent metamorphic transformation. Two Sections will deal with pulsations and cycles of earth movement and with their effects upon the nature of the stratified rocks and upon the evolution of organisms. Three other Sections are all concerned—though each has its own special field of discussion—with the refinement of the scale by which geological time is divided and by which rock formations are dated, and with the particular use to this end of the fossil remains of terrestrial and aquatic organisms. In another Section there will appear a fascinating story of recent researches, aided by modern apparatus, into the structure and composition of the sea and ocean floors.

All these discussions are in the realm of pure science; though the methods and results described have much practical importance. Three other Sections, however, will deal directly with aspects of applied geology—with the use of physical instruments in the elucidation of the deep structures of the earth's crust; with the search for mineral oil; and with the geology and the reserves of the ores of lead and of zinc. Geologists in many countries have contributed to a special symposium

on this last subject, and the resultant reassessment of the natural reserves of these essential metals affords some reassurance.

In addition there will be a series of meetings at which will be read a miscellany of papers outside the scope of the subjects to which I have already referred; and I may mention that the Executive Committee has experienced an embarrassment of riches in the papers offered to this 'Other Subjects' Section. There is, unfortunately, time for the presentation of only a small fraction of their total.

Besides these Sectional meetings for the presentation of original thought and research, there are of course many other items in the technical programme; I would draw your attention specially to two of these; to the two Special Addresses to this Assembly in which two senior British geologists will offer a summary of our present knowledge of the Structural History of Great Britain—a synthesis of the work of many hundreds of British geologists during the last century and a half.

During the coming week the Council of the Congress will meet on several occasions, and among its duties will be to reinstate the permanent Commissions of the Congress—the standing international bodies, each with special purpose, which normally continue their work between the Sessions, but which have mostly become disrupted by the years of war; and the Council will also consider whether any new mechanism for a permanent international committee of geologists is practicable and desirable. The Council will report its findings to a business meeting of this Assembly on August 31st; and on September 1st the Assembly will meet for the third and last time and will bring the Session to a formal end.

This whole programme of organized discussion is important. But in planning the Session the Committees have felt it at least equally important that members shall have ample opportunity for informal meeting and discussion, and opportunity to travel together and to see the geology of Great Britain in the field.

This is a small country, but it contains perhaps a greater variety of geological formations than any other territory of similar extent; and there are many classic areas and type sections where the principles of stratigraphy and structural geology were first deduced and where many of the Systems were defined and named. Great attention has therefore been given to the development of the excursion programme of the Session. The two groups of long excursions cover almost the whole of Great Britain. Many who are present here have lately returned from the first group of these excursions; and other long excursion parties totalling several hundreds of members will leave London again about a week hence. Meanwhile, during the period of the Session, there are arrangements for nearly one hundred separate short geological excursions and visits providing for the mingling and interchange of members travelling in fresh parties each day. The greatest value of this Congress may perhaps be in the opportunity which these excursions, long and short, offer for the revival of old scientific friendships and the beginning of new ones.

The development of geological science has had profound effects upon our philosophy and upon our way of life. It has given us a perspective by which we may assess man's humble place in the long history of the earth and in the procession of organic evolution. It has also given us the opportunity, if we so wish, to exploit the mineral products of the earth to the common advantage. To-day, there are present some 1,400 visitors to this Congress, and over 80 countries are represented. The assembly in these troubled times of so great a body of specialists in the science of geology, meeting for the specific purpose of mutual co-operation and interchange of ideas, is an encouragement for the future.

I offer again to this Assembly, on behalf of all British geologists, a warm and sincere welcome to Great Britain."

On behalf of the General Assembly the President asked Sir John Anderson to accept grateful thanks for his address.

At the request of the President, Professor L. Hawkes, General Secretary, then read proposals for



the Officers of the Sectional Meetings, and for procedure at those meetings, as agreed at the Preliminary Meeting of the Council. The proposals were approved by acclamation.

Finally, the President spoke as follows:—

“I now offer my best wishes to the Assembly for its work during the Session. As we have just heard, there is a very attractive programme and many of us would like to be in several places at once. I wish you all good debates and an abundance of good fellowship. I have no doubt that at this Session, as at previous Sessions, great numbers of friendships will be forged that, come what may, will never be broken.

I declare the first Meeting of the General Assembly of the Eighteenth Session of the International Geological Congress to be closed.”

The Organ of the Royal Albert Hall was played, before and at the close of the Assembly, by Dr. K. C. Dunham.

## Business Meeting of the General Assembly, in the Royal Albert Hall, at 9 a.m. on Tuesday, August 31st, 1948

Professor H. H. Read (President) was in the Chair.

Two hundred and seventeen members were present.

### 1. MINUTES OF THE PREVIOUS MEETING

The Chairman informed the General Assembly that the minutes and formal record of speeches delivered at the first Meeting of the General Assembly on August 25th would be printed in the General Report of the Session, and he asked that they be taken as read.

*This was agreed.*

### 2. BUSINESS OF THE PRESENT MEETING

The Chairman explained that by the Constitution of the Congress the resolutions which had been passed by the Council must be agreed by a Minute of the General Assembly, in order that all members of the Assembly might be fully acquainted with the resolutions and so that the agreement of the Congress as a whole might be recorded.

The membership of the Council of the present Session had been particularly large and widely representative, and it might therefore be reasonably assumed that the conclusions of the Council would be likely to have the general agreement of the whole Congress. The present meeting of the General Assembly had, however, been called to complete the formal procedure and to communicate the findings of the Council.

There was additionally a certain amount of business with regard to the Commissions of the Congress and the International Paleontological Union which it had not been possible to complete before the close of the last meeting of the Council, and it had therefore been referred to the General Assembly for direct confirmation.

### 3. PLIOCENE-PLEISTOCENE BOUNDARY

Dr. K. P. Oakley (Great Britain) presented the report and recommendations of the Temporary Commission on Problems connected with the Pliocene-Pleistocene Boundary.

Sir Edward B. Bailey (Great Britain) asked Dr. Oakley whether there had been substantial agreement in the Commission.

Dr. K. P. Oakley (Great Britain) replied that the members of the Commission had been practically unanimous in its recommendation. The recommendation had been read out to a general meeting of Section H, attended by over 150 members of the Congress, and there had been one vote to the contrary. It had, therefore, been passed by a very large majority by a representative body which was especially interested in the question.

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Dr. R. C. Moore (U.S.A.) said that inasmuch as the recommendation expressed competent opinion and did not seek to settle a scientific question by edict, he thought it was very appropriate and that the recommendation could be adopted.

*The report and recommendations were adopted.*

### 4. PREPARATION OF A WORLD PHYSIOGRAPHIC PROVINCE MAP

Dr. Louis Ray (U.S.A.) presented the report and recommendations of the Commission, which were *adopted*.

### 5. CHEMICAL ANALYSIS OF METEORITES

Professor W. Wahl (Finland) presented the report and recommendations of the Commission, and these were *adopted*.

### 6. INTERNATIONAL PALEONTOLOGICAL UNION

Professor P. Pruvost (France), President of the International Paleontological Union, in presenting the report and recommendations of its meetings, said that the International Union had been created at the Congress in Washington and had since worked in close co-operation with the Congress. He wished to express thanks to the General Organizing Committee of the Congress for the help it had given to the International Union.

*The report and recommendations were adopted.*

### 7. INTERNATIONAL ASSOCIATION OF VOLCANOLOGY: COMMUNICATION BY DR. L. GLANGEAUD

Professor L. Hawkes (General Secretary), on behalf of Dr. L. Glangeaud, informed the General Assembly that the International Association of Volcanology, at its Oslo Congress in 1948, had formed a Committee for the study of early eruptive phenomena. Circulars would be sent to the specialists of all countries soliciting their assistance in the work of the Committee.

### 8. WORK OF THE COUNCIL: GENERAL SECRETARY'S REPORT

Mr. A. J. Butler, General Secretary, presented the following report on the work of the Council of the Congress.

## GENERAL SECRETARY'S REPORT

The Council of the Congress has met on four occasions. At the First Meeting the constitution of the Bureau and Council of the Session was agreed together with certain propositions regarding voting procedure. The proposition for the officers of the sectional meetings and for procedure at those meetings was also confirmed.

The results of that meeting were placed before the First Meeting of the General Assembly on August 25th and were there confirmed.

At subsequent meetings of the Council the major items of business were as follows:—

(1) It was agreed after discussion that the Russian language be an official language of the Congress.

(2) It was agreed that the Nineteenth Session of the Congress shall meet in Algiers in 1952 on the invitation of the Government of France and the Governments of French territories in North Africa. The Council had before it two attractive invitations, the one to meet in Algiers, and another from the Government of India to meet in India at some time during the period November, 1951, to February, 1952. While accepting the former, which had first been brought to the notice of the Council during the Seventeenth Session in Moscow in 1937, the Council expressed to the Government of India its most cordial thanks for their invitation coupled with the hope that the invitation to India might be reaffirmed at the Nineteenth Session.

(3) The question of forming an International Union of Geology was discussed in detail. It was agreed that a decision on this question should be postponed, but that meanwhile the Bureau of the Congress should be prepared to advise UNESCO on geological matters.

(4) With the previous agreement of the Council a joint meeting of representatives of the existing commissions of the Congress was held on March 26th. It was agreed that the Commission on Petrology, Mineralogy and Geochemistry should be dissolved, and that the work of the Commission on the Determination of Geological Age by Radiological Methods should for the moment be suspended.

It was also agreed that the Commission on Fossil Man should be transferred to the International Paleontological Union.

Sir Edward Bailey was requested to enquire into the desirability of reconstituting the Commission on Geophysics and Geothermics, and subsequently recommended after consulting interested members that this Commission should be dissolved. The Council accepted this recommendation.

All the remaining commissions which were in existence before the Eighteenth Session were reconstituted and have presented reports to the Council.

(5) Certain other committees and commissions, some of a temporary nature, were set up at the second meeting of the Council, and will report directly to the General Assembly at its present meeting.

(6) The Council also considered a recommendation from the Society for the Preservation of Nature Reserves concerning the establishment of national geological reserves. This recommendation was accepted and it was agreed that the Bureau should be instructed to communicate to the Governments represented at the Eighteenth Session through their national delegations a strong resolution urging Governments to take steps to preserve important geological features and type sections.

The Chairman said that the findings contained in the report had been discussed and accepted by a large meeting of the Council, over 200 members being present; but if there were any inaccuracies or emendations which members of the General Assembly would like to discuss, it would be open to them to do so.

Professor V. V. Belousov (U.S.S.R.) said that the Soviet delegation wished to state its opinion on the question of the relations of the Congress with UNESCO. The Soviet delegation agreed that the question of the creation of an International Union of Geology should be postponed until the next Session of the Congress, and such had been the content of the Soviet proposal which had been rejected by the narrow majority of one vote, 64 being in favour of that proposal and 65 against it.

The Soviet delegation, however, was categorically opposed to that part of the Council's decision which stated that the Bureau of the Congress was instructed to give advice and supply information to UNESCO or any other political organizations.

The Soviet delegation still maintained that the International Geological Congress was the only free institution of scientists and that it ought not to be made dependent upon any other organizations. If the Bureau were to undertake the responsibilities and obligations envisaged in the Council's proposal, it would mean putting the Congress into a position of being dependent upon other organizations.

The Soviet delegation requested that its special opinion on this matter should be recorded in the Minutes of the General Assembly.

The Chairman said that the special opinion of the Soviet delegation would be recorded in the Minutes of the General Assembly.

In asking the General Assembly to approve the contents of the Report, he wished to refer particularly to one of the most important items in that report, namely, the agreement that the next Session of the Congress should meet in North Africa. He reaffirmed the gratitude of the Council and of the Assembly to the Government of France and to the Government of India for the generous invitations which they had so kindly tendered to the Congress.

*The report was adopted unanimously.*

The Chairman said that if Dr. Wadia of the Indian delegation had been present, he had intended to thank him personally, and through him the Government of India, for the invitation to the Congress to meet in a country which all geologists would like to visit. It had not proved possible to accept that invitation immediately, but he trusted that the Government of India might be able to reaffirm their



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invitation for consideration at the next Session of the Congress. Meanwhile, he would ask Dr. Wadia to transmit to the Government of India the warm thanks of the General Assembly.

Addressing Dr. Lutaud of the French delegation, the Chairman said that the General Assembly of the Congress had been pleased to accept the kind invitation of the Government of France to hold the Nineteenth Session in Algiers. All members would look forward to that Session, and would hope to join Dr. Lutaud and his colleagues in North Africa, and travel with them in excursions over a country which was of special interest to geologists on account of the striking researches which had been carried out there in recent years.

To-morrow, at the final meeting of the General Assembly, he proposed to ask Dr. Lutaud to make the last speech in the series of farewell speeches by the heads of Government delegations—for Dr. Lutaud's speech would only be *au revoir*.

Dr. L. Lutaud (France), replying to the Chairman, said that yesterday, after a very courteous discussion by members of the Council, he had, perhaps rather prematurely, expressed his thanks to the Council for its kind acceptance of the French Government's invitation. There was perhaps not much difference between the membership of the Council and that of the General Assembly; nevertheless, according to the constitution, it was only to-day that he could definitely know that the invitation was accepted.

Yesterday he had expressed his warm thanks, and all he could do to-day was to repeat and amplify them. In the meeting of the Council there had been a friendly competition with India. The French delegation wished to express thanks for the way in which the Indian delegation had sparred with them and also for the very courteous manner in which they had given way. He sincerely hoped that he would be in a position to see and enjoy all the fine things which the Indian Government had prepared for the Congress, and that there would be that opportunity at the Twentieth Session. Meanwhile, French geologists had some fine things to show the Congress: showing them would be a heavy task, but France counted it an honour to take on that task and would do her best to provide the Congress with a varied and interesting programme.

Finally, he wished to thank the Bureau and all geologists for the very kind things that had been said with regard to the invitation.

The Chairman thanked Dr. Lutaud for his remarks.

### 9. MINUTES OF THE PRESENT MEETING

The Chairman asked the General Assembly to entrust the Minutes of its present meeting to the Bureau of the Congress, and this was *agreed*.

### 10. GENERAL SECRETARY'S ANNOUNCEMENTS

Mr. A. J. Butler, General Secretary, made announcements concerning the meeting of the General Assembly on Wednesday, September 1st, and the meeting of the Bureau.

### 11. THANKS TO INTERPRETERS

Mr. A. J. Butler, General Secretary, expressed thanks to the interpreters who had helped the Council and General Assembly throughout their meetings.

The Chairman wished to associate himself and the General Assembly with that expression of thanks.

### 12. CLOSURE OF MEETING

The Chairman, in declaring the meeting closed, thanked the General Assembly for the way it had carried out its business. He recognized that he might have seemed like a steamroller on occasions, but he asked members to believe that even a steamroller may have a kind heart.

*The General Assembly rose.*



# Final Meeting of the General Assembly, in the Royal Albert Hall, at 10.30 a.m. on Wednesday, September 1st, 1948

Professor H. H. Read (President) was in the Chair.

## 1. MINUTES OF PREVIOUS MEETINGS

The President, in opening the meeting, recalled that at a business meeting of the General Assembly held the day before, the Resolutions of the Council of the Session had been approved; and at the present meeting there was therefore little formal business to transact. He asked the General Assembly to agree that the Minutes of the Business Meeting be presented to the Bureau.

*This was agreed.*

## 2. AWARD OF THE SPENDIAROV PRIZE

The President said that this was the only prize which was awarded by the Congress. It had been endowed in 1897, when the Congress had met in Russia, in memory of a young Russian geologist named Léonide Spendiarov, and had been awarded at each succeeding Session of the Congress to some member of the Congress in appreciation of researches published during the years immediately preceding each Session.

The delegation of the U.S.S.R. had proposed that the Spendiarov Prize for the Eighteenth Session be awarded to a British geologist, and the Commission for the Spendiarov Prize had selected Professor L. R. Wager as the recipient. He asked the Head of the Soviet delegation to address Professor Wager.

Professor V. V. Belousov (U.S.S.R.) said that at each Session of the International Geological Congress this prize was given to a scientist whose work represented something new in geological science and whose persistence and will in scientific work set an example to others. The prize had been awarded in the past to many scientists whose names were outstanding.

He now had pleasure in naming Professor L. R. Wager of the University of Durham as the recipient of the Spendiarov Prize. Professor Wager was known as an investigator of the geological structure of the Himalayas and Greenland, and had shown in his work, mainly in the field of petrology, those qualities which guaranteed progress in science—talent, keenness in observation and a strong will.

Professor Belousov was happy to be the first to congratulate Professor Wager and to wish him further success in his work.

Professor L. R. Wager (United Kingdom), in replying, said that he was highly appreciative of the distinction which had been conferred upon him by the International Geological Congress in awarding him the Spendiarov Prize. He thanked Professor Belousov for the tribute he had paid to his endeavours in various fields of geology and petrology.

Professor Belousov had referred to his work among the high mountains. In those high mountains, which so liberally rewarded the efforts of geologists, a man could not safely go alone, but only with well tried companions. So it had always been in his geological work: it would never have been possible without the generous and active support of many geologists and other scientists, and the goodwill of the universities to which he had belonged. Among many names, he wished to mention particularly that of his friend and collaborator, W. A. Deer, who even at this moment was at work in the Arctic regions of Canada seeking there the continuation of the Tertiary igneous activity of the North Atlantic.

In receiving an honour such as the Spendiarov Prize, he was conscious of all that a man owed to his local environment, especially to his teachers. For a period of years he had lived in the critical atmosphere of the Cambridge School of Geology, and he hoped that he had successfully preserved that attitude of mind. Harker had been his teacher; and now he found himself at work in the Isle of Skye, which Harker, above all others, had made a classic ground to geologists.

But geology, like all other sciences, was international. Any good work accomplished by an individual was based on the work of the great geologists of the world, present and past. The International Geological Congress emphasized the international aspect of geological science. Because so many of

the studies of geologists were limited to restricted regions, it was all the more important for geologists to be periodically reminded by such meetings as the Sessions of the International Geological Congress of the fundamentally international basis of geology.

He thanked Professor Belousov for all that he had said and the International Geological Congress for the honour it had done him.

### 3. CLOSING SPEECHES

The President:—

“Members of the Eighteenth Session of the International Geological Congress: On behalf of the geologists of Great Britain I extend to you all our gratitude for accepting our invitation to this meeting in London. In spite of countless difficulties you have nevertheless persisted in coming here in record numbers. We thank you individually for that persistence because it has enabled us in Britain to do what we have been able to do for the greatest possible numbers.

In these record numbers you have inspected our country and you have inspected us. I trust that you have found both worthy of your visit.

We have endeavoured to display the leading geological features of Britain. I hope you have derived permanent geological benefit from those displays, but whether you have or not I am sure you have derived benefits of another kind. You have become friends. Friendships begun over coffee cups, strengthened by buffetting in buses, and cemented by sharing the common rain and the all too uncommon cigarette—such friendships will last for ever. We are glad that indirectly we have been the agency by which a multitude of such friendships has been produced. For too long many of us have made contacts with one another only by the written word, but the written word cannot replace the mutual inspiration which flows from personal contacts however non-geological such may be.

Two other things I have to be thankful for and they are your regional variety and your scientific variety. A study of the list of members of the Session shows the astounding array of countries, large and small, industrialized or not, from which you have come. No other gathering can have been so truly international as this one of ours. And we are gratified at the breadth and depth of the geological thought represented in this Congress. Here are present specialists in all branches of geology both pure and applied. Our enquiries have ranged from beneath the deepest ocean to the summits of the highest mountains, across all the continents and through all the systems, from the minute details of crystal structure to the history of half the earth. I have said we have specialists in all branches of geology and these branches appear to increase and proliferate with great rapidity. It is possible that we shall be required soon to establish specialists in generalization—a suggestion that the Bureau might profitably consider.

We British geologists, during these few weeks we have been together, have received from you all vast and immeasurable stores of knowledge and wisdom upon which we shall draw in the duller times that await us when you are no longer with us. We shall delight to remember the countless occasions on which your collective and world-wide experience has lit up the dark corners of our insular ignorance. This is the most stimulating event that can happen in the lives of all British geologists and is one that we shall never forget. Members of the Eighteenth Session of the International Geological Congress, we shall never be able to express to you the magnitude of the honour that has been done to us by your visit. We can only trust that you have found here in Britain and in British geology some small recompense.

It is now my pleasure to ask representatives of the national delegations to speak. The problem of the order in which such speeches are to be arranged has been variously solved at earlier sessions of the Congress. I propose to-day to call first upon Dr. Eliot Blackwelder, the Head of the delegation of the United States of America where the Sixteenth Session was held, then upon Professor Belousov, the Head of the delegation of the Union of Soviet Socialist Republics who were the

hosts of the Seventeenth Session; then the heads of other delegations grouped according to the continents in which they work will successively address the Assembly.

Finally I shall call upon Professor Lutaud, the Head of the delegation of France. An invitation from the Government of France to hold the Nineteenth Session in Algiers was yesterday accepted by the General Assembly, and it therefore seems appropriate that as representative of the future organizers of the Congress Professor Lutaud shall speak nearest to the point where the present Session concludes and the Nineteenth Session begins.

Dr. Eliot Blackwelder, you are the Head of the delegation of the overseas country whose representatives are, I think, most numerous at this Session, and I ask you to address the Assembly."

Dr. Eliot Blackwelder (U.S.A.):—

"Mr. President and Members of the Congress:

On behalf of the delegation of the United States of America I take pleasure in offering a few words of appreciation to our British friends who have made it possible to hold here one of our most successful congresses. Those of us who have had a hand in earlier meetings of the sort can best realize how much devoted effort is involved in bringing such an undertaking up to the standard reached here. And there can follow it little more reward than the realization of good work well done, the meeting of friends and the gratitude of all the members, who are the chief beneficiaries.

From all over the world geologists are drawn to Britain, as one of the classic grounds for the study of their science. It is not only a pleasure but a very useful experience to visit, under the guidance of our British colleagues, the localities where men like Smith and Murchison worked out, at an early day, the system of the rocks and where their modern successors continue to untangle the intricacies of the geological story.

On last Wednesday morning I was glad to hear Sir John Anderson commend the work of the amateur geologist in the development of our science in the British Isles. Personally I should like to pay a special tribute to those amateurs who, by careful observation and honest reasoning, have contributed greatly to our knowledge of geology. James Hutton, William Smith, Charles Darwin, and a host of men like them, had no government support and drew their initiative from no higher authority. Their own desire for understanding was enough, but the whole world has been enriched by them.

It is a great privilege to be here among colleagues from many lands, after so long an interval. Many of us had laid definite plans to come to London in 1940, but instead we were obliged to wait, and could only watch with anguish the savage attacks upon this devoted country by a frustrated tyrant.

We cannot but admire the courage of our British confrères in undertaking to renew their invitation to the geologists of the whole world, so soon after the end of the most destructive war in history and while still suffering severely from the effects of that disaster. It must have been a real sacrifice for them to bring it about.

This very city of London, still bearing many of the scars of its gallant resistance to the attempt of the enemy to hammer it into submission, is the symbol of an indomitable spirit. We know that in the years of crisis its geologists turned to its defence, becoming soldiers, fire-wardens, or members of the Home Guard; for liberty has always been their most cherished possession.

It has been a source of gratification and no little surprise that so many geologists from all over the globe have been able to attend this Congress, in spite of unusual obstacles. We regret the absence of others who have been prevented from doing so by the lack of transport, by money restrictions and other barriers. Some of us can recall the Geological Congress of 1903, at Vienna, when money was freely exchangeable, travel was easy, and scholars circulated readily throughout Europe. Even passports were not then required, except in two countries. To a younger generation these conditions may seem strange; but is it not even stranger that they are not still normal? Science, as well as other human activities, can really prosper only in an atmosphere of complete



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freedom of inquiry, communication and publication. Regrettably enough this condition does not now prevail all over the world; but we should work steadily toward it as an eventual goal.

The love of justice and liberty may well have been an essential factor in stimulating the early development of science in these islands. To learn the facts and principles of Nature, the scholar must be genuinely free to follow them in any direction. And to be free he must live under a political system which provides that degree of personal liberty.

But such a system is not to be had merely for the wishing. While working at their science geologists will do well to give a due measure of attention and constructive effort also to human affairs—especially in the field of international relations. Progress in Geology depends upon a reasonable degree of stability in world conditions, and particularly on the prevention of general wars; for if our civilization should be ruined, all science would vanish with it.

To many of us it now seems clear that the world faces only two possible alternatives for the near future: adequate political integration, or some variety of chaos and a reversion to barbarism. The integration might come about by the age-old method of conquest, or it might arise by the newer and far more hopeful method of the voluntary union of free peoples. Of these two only the second can be truly beneficial to the progress of Science and of Humanity itself.

For many decades it has been the normal habit of geologists and their fellow scientists to overlook those things which tend to divide men into jarring groups. Instead they have worked together as a world-wide fraternity, seeking their common goal of the truth. The more widely that attitude is adopted by the people of any country, the nearer its approach to real civilization.

Again, in closing, I bring from my fellow members of the United States delegation the heartiest expression of their gratitude to the Geological Society of London, to H.M. Geological Survey, to the University of London, and to all the British geologists and others associated with them in bringing this Congress to so happy an outcome."

The President:—

"On your behalf, I thank Dr. Blackwelder. I now call upon the Head of the delegation of the Union of Soviet Socialist Republics, whose geologists so successfully organized the Seventeenth Session."

Professor V. V. Belousov (U.S.S.R.):—

"On behalf of the Soviet delegation I wish to thank the President, General Secretaries and General Organizing Committee of the Eighteenth Session of the International Geological Congress for the hospitality which has been rendered to us and for making it possible to visit some of the regions of Great Britain which are of great interest to geologists.

In conclusion allow me to wish you all every success in your future work."

The President:—

"We thank Professor Belousov, and we now come to those representatives upon whom we shall call continent by continent. We begin with Africa."

Dr. S. H. Haughton (Union of South Africa):—

"Those members of Congress who have journeyed from the southern lands of the Union of South Africa and the Mandated Territory of South-West Africa are full of gratitude for the privilege which has been afforded to them of attending this Eighteenth Session of the International Geological Congress which has been held in the cradle of geology.

In addition to the official delegates of the Governments of the two countries at the southernmost end of the African continent, there have been present delegations representing the Geological Society of South Africa, the Chemical, Metallurgical and Mining Society of South Africa, the South African Association for the Advancement of Science, the Albany Museum, and the Universities of Cape Town and of the Witwatersrand. This may, I think, be construed as evidence of the interest which South Africa rightly takes in geology; and I say 'rightly' because our country's economy is largely dependent on the development of its mineral resources.

Nearly twenty years ago, we had the honour of acting as hosts to the Fifteenth Congress. We



believe that our organization of that Congress was moderately successful; but I am certain that the prize for organization must be awarded, without anyone dissenting, to the Executive of the present Congress, and in particular to the President, the Organizing Secretaries and the Treasurer. Catering, as they have had to do, for the happiness of more than 1,700 people, they have not failed in any respect. The geological fare placed before us in the sectional and the general meetings, the opportunities given to us for field studies in both the long and short excursions, the arrangements made for social intercourse and for the renewal of old friendships as well as the formation of new ones, all call for the highest praise.

They have even propitiated the Controller of the English weather—a feat that illustrates both their power and their attention to the smallest of details. And with all this, they have remained unruffled and seemingly pleased to have us with them.

My South African colleagues desire me to express our unanimous belief that this Eighteenth Congress will go down in history as a perfect example of what an international gathering should be and should achieve; and we therefore offer to our hosts and friends our very grateful thanks for the magnificent and inspiring time that we have had during this all too short visit."

Dr. M. I. Attia (Egypt):—

"Mr. Chairman—As the delegate of the Egyptian Government and on behalf of the delegates of the institutions and universities of Egypt, I wish to thank the Chairman and Members of the Organizing and Executive Committees for the excellent arrangements they made for the excursions and meetings which have made the Session so eminently successful.

I also wish to express our gratitude to H.M. Government and to the scientific institutions for the cordial welcome and hospitality extended to us and for the kindly manner in which we were received by all those with whom we came in contact."

The President:—

"We now turn to the Americas."

Dr. M. E. Wilson (Canada):—

"On behalf of the geologists of Canada attending the International Geological Congress, I would first like to tell every citizen of Britain in this hall how much we appreciate and admire the fortitude of the British people both during the war and now during austerity; but despite the difficulties of austerity we have attended a Congress that for completeness of arrangements and for the smooth uninterrupted way in which meetings and excursions have gone forward has never been surpassed and possibly never equalled.

We have greatly increased our knowledge of geology, we have seen the beautiful scenery of the British Isles, we have visited many places of historical interest, we have renewed old friendships and have acquired many new friends. For all these we are deeply grateful. We thank Professor Read, Mr. Butler, Professor Hawkes, the chairmen of committees, the leaders and secretaries of excursions and everyone associated with these gentlemen for an outstandingly successful gathering. We have had a delightful time which we shall always recall with the greatest pleasure."

Mr. Alberto Ribeiro Lamego (Brazil):—

"I wish simply to express thanks for the cordial welcome which members of the International Geological Congress have received in Great Britain. At this last meeting of the General Assembly, I wish all happiness to all of you, and especially to my friends in Great Britain, who have received us so kindly."

The President:—

"As the General Assembly knows, the Government of India, through Dr. Wadia, most generously invited the Congress to hold the next Session in India. Although it has not been possible on this occasion to accept that invitation, may I, in calling first upon Dr. Wadia among the delegates from Asia, express the hope that the invitation may be reaffirmed in the future?"

Dr. D. N. Wadia (India):—

"Sir, I wish to be allowed to speak a few words on this occasion. On behalf of the Indian

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delegates, while endorsing fully everything that has been said by previous speakers, I wish to add our sincere tribute to the Executive of the great organization for their perfect organization and planning in every detail. One can easily realize how much thought and wise planning has gone into all the arrangements of this Congress, both its scientific activities and its business and social activities. I particularly refer to the excellent system devised for the smooth and efficient working of the various Sections. One can only wish such system, classification and order is followed in the conduct of scientific work of future International Conferences.

Sir, I thank you for your kind references to India's invitation to the International Geological Congress to hold its Twentieth Session in India. India has extended a cordial invitation and will look forward to the privilege of welcoming this august body of scientists."

Dr. C. P. A. von Emmichhoven (Netherlands East Indies):—

"Mr. President, Ladies and Gentlemen:

On behalf of the Government of the Netherlands East Indies, of my colleague Dr. van Bemmelen and on my own behalf, I beg leave to offer to the Geological Society of London our sincere thanks for their kind invitation to my Government to be represented at the Eighteenth Session of the International Geological Congress. We appreciate the honour of this invitation all the more, as we could hardly be expected to contribute to the scientific results. For by the war with Japan and by its aftermath, all activity of our Geological Survey since December, 1941, has been and is still paralysed. Moreover, our archives and equipment have been rediscovered in a most deplorable state of disorder, and many of our latest records have been proved to be incomplete. I can announce that our Geological Survey is now engaged in editing a work *The Geology of the East Indies and adjacent archipelagos* by Dr. van Bemmelen but, much to our regret, it could not be finished in time, so that we must miss the pleasure of presenting it to the International Geological Congress at this session.

For these reasons our Government had wondered for some time whether it had not better renounce her participation in this Congress. But finally this scruple was pushed aside in considering the high opinion that we have of British hospitality and the great esteem in which British geology is held. So we trusted that we would be welcome, even if no tribute to the scientific success could be paid on our part. And then, we would have been very reluctant indeed to dispense with this fine opportunity to meet your eminent geologists, to participate in your highly instructive excursions and thus to find impulses to new thoughts, which doubtless will be of great help to us in the difficult years to come of rebuilding our Geological Survey. All these expectations, high strung as they were, still have been exceeded.

Though it is difficult for me to find the words adequate to my feelings, I am glad of this opportunity for expressing our gratitude for all you have done for us and for the warm hospitality which you have extended to us. Personally, I wish to refer in particular to the A.1 excursion, which for perfect organization and pleasant leadership could hardly be surpassed; nor would I like to omit my sincerest thanks to the numerous companies and private citizens, who have done so much to make this A.1 excursion in every respect A.1.

Mr. President, on behalf of my Government, Dr. van Bemmelen and personally I beg to have you convey our heartfelt thanks to the Organizing and Executive Committees, to the Geological Society of London, and to the Government of the United Kingdom."

Mr. S. C. Moll, Jr. (Philippines):—

"Mr. President, Delegates and Members of the International Congress, Ladies and Gentlemen,

The Philippine delegation is privileged to have been in London for the past few days on the occasion of the Eighteenth Session of the International Geological Congress. In spite of the obstacles to the organization of this Assembly, the presence here of more than sixteen hundred delegates and members from near and far is a tribute, not only to the continued and increasing interest in the geological sciences, but likewise to the excellent work of the organizing committee.

The sectional meetings afforded us an opportunity to hear discussion on matters of common

interest; the field excursions enabled many of us to learn much more about the geology of this country and, at the same time, to enjoy the lovely countryside for which Britain is justly famous.

As the Eighteenth Session of this Congress comes to a close, I should like to express deep appreciation to His Majesty's Government for the invitation extended to the Philippines. In the not too far distant future I hope that my country may be privileged to be a host to the International Geological Congress. Among other things the rich mineral deposits there should be a source of interest to our members. Then, too, it would give us the greatest pleasure to return, in small measure at least, the warm hospitality of the Organizing Committee and the British people."

Professor H. N. Pamir (Turkey):—

"Monsieur le Président, Mesdames, Messieurs,

Au nom des Institutions géologiques et de la Société géologique de Turquie, je tiens à exprimer ma profonde reconnaissance pour le noble pays qui nous a réservé un si magnifique accueil, et pour ses illustres savants que nous admirons depuis toujours, mais qu'aujourd'hui nous apprécions plus encore dans leur personne.

Nous avons assisté avec un intérêt particulier aux séances des commissions, aux visites à vos superbes musées et bibliothèques qui témoignent, mieux que tous, combien la science est appréciée ici. Nous avons pris part avec le plus grand intérêt aux excursions, guidés par les meilleurs explorateurs, qui nous ont fourni l'occasion de connaître sous ces divers aspects votre beau pays.

Mesdames et Messieurs,

Permettez moi de vous dire en deux mots, dans quel esprit mon pays considère ces réunions scientifiques. Nous aimons à espérer que les ressources de la Science qui ont été si puissantes dans la guerre, se montreront encore plus efficaces à fortifier la cause de la Paix. Nous aimons à croire que nous, chercheurs de la Terre, la Terre à nous tous, nous avons un seul et un même but; celui de faire progresser la science; cette science qui est la source de la prospérité générale! Nous aimons enfin à penser que par la généralisation de l'esprit scientifique, une meilleure intelligence pourra regner entre les hommes.

C'est cela que nous avons fait ici. Au seuil d'une ère plus heureuse, nous emportons avec nous des amitiés nouvelles, une enthousiasme rajeunie pour notre belle science, et aussi un souvenir particulier de ce beau pays, que nous quitterons avec regret."

Dr. H. Crookshank (Pakistan) and Mr. E. Homayounfar (Iran) also communicated the thanks and good wishes of their delegations.

The President:—

"We have been specially glad to welcome representatives from those parts of the earth most distant from this country—from Australasia.

I call upon Mr. Ongley of New Zealand."

Mr. M. Ongley (New Zealand):—

"We who have come from the most remote and one of the smallest and loveliest lands on the earth wish to express cordial thanks for the great and generous feasts of geology at this Congress, which has been so inspiring, stimulating, co-operative and happy.

To show that our gratitude is not only on our lips, we ask you to give us the opportunity of expressing it in more material ways by your visiting us, and giving us the opportunity of welcoming you, at the Pan-Pacific Science Congress which is to be held in New Zealand next year. You cannot do better than follow the example of our King and Queen—learn Maori and visit New Zealand. I close by giving you the invitation in Maori: 'Kapai, Nacremai, Aotea roa, Kia ora,' which being interpreted is, 'It is good for us to be here in old England; we shall welcome you to young New Zealand, young and fair New Zealand; till we meet again.'"

Dr. H. G. Raggatt (Australia):—

"Mr. President,

I am sure all Australian geologists would desire me to express to you our sincere thanks for the excellent way in which the Congress has been conducted.



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It is a great privilege to have a first-hand opportunity of seeing so many of the type sections under the guidance of those who have studied the sections in detail, and the personal contacts made during the excursions will last a lifetime.

After careful investigation we have decided in Australia that apart from very sparse pastoral settlement, the development of 50 per cent of Australia depends upon finding workable mineral deposits therein. Therefore progress in the application of geological science to this problem is vital to our national development. The more we learn about the fundamental principles of geology the better shall we be equipped to deal with economic problems."

The President:—

"And now we return to Europe, the first home of the Congress. Here I call first upon Professor Fourmarier."

Professor P. F. J. Fourmarier (Belgium):—

"Monsieur le Président, Mesdames, Messieurs,

Il y a trente ans, la première grande guerre mondiale prenait fin; les peuples renaissaient à la vie et à l'espérance.

Oubliant les souffrances causées par l'occupation étrangère, un petit pays prenait la charge d'organiser la Treizième Session du Congrès géologique international. Moins de quatre années après que les armées eurent déposé les armes, les géologues de toutes les nations se réunissaient sur le sol de Belgique pour reprendre en commun le travail interrompu.

La Belgique marquait ainsi sa foi dans un avenir meilleur; elle affirmait que la science ne connaît pas d'arrêt dans sa marche en avant, quels que puissent être les obstacles que les hommes eux-mêmes dressent en travers de la voie du Progrès.

Aujourd'hui la deuxième guerre mondiale est terminée depuis trois ans à peine. Déjà la Grande Bretagne a pu renouveler le geste de fraternité envers tous les savants du Monde. C'est sur son territoire que se tient la Dix-huitième Session du Congrès.

Nous devons admirer son effort gigantesque et sa confiance dans l'avenir de la science. Comparable en apparence à celle de 1922, la situation est cependant tout autre qu'au temps où la Belgique préparait la Treizième Session.

A cette époque—il y a trente ans à peine—l'avenir apparaissait tout baigné de lumière; beaucoup s'imaginaient que la Paix était pour toujours établie sur la Terre. Aujourd'hui les peuples se gardent de telles illusions; tout sentent que l'avenir est peut-être incertain; le bruit des armes s'entend encore en bien des points du Monde; les hommes ne peuvent prévoir ce que réserve Demain!

Malgré cela, et dans des conditions bien plus difficiles qu'il y a trente ans, les géologues de Grande Bretagne ont voulu faire honneur à leurs engagements librement consentis. Ils ont organisés une session du Congrès qui fut particulièrement brillante. Ils ont croit à notre profond gratitude.

Les excursions ayant pour objectifs les régions les plus intéressantes du Royaume Uni ont eu un succès considérable, et les géologues étrangers en ont largement profité. Les séances des sections ont été suivies par un auditoire nombreux et attentif, attiré par leur variété et l'éclectisme des sujets mis à l'ordre du jour.

Au nom des géologues belges, je tiens à exprimer au Comité organisateur toute notre reconnaissance pour le travail accompli. Je veux assurer aussi tous les géologues de la Grande Bretagne et de l'Empire de notre admiration pour l'œuvre qu'ils ont réalisé dans le domaine des sciences minérales au cours de ces dernières décades.

Je fais le vœu, que, dans l'avenir, cet effort se poursuivre et que la Grande Bretagne reste, comme par le passé, au premier rang des nations dans le domaine pacifique de la pensée humaine."

Professor Dr. Karl Metz (Austria):—

"After a long and unhappy time of separation this Congress has been the first occasion for our geologists in Austria to get in personal touch again with our friends from all over the world.



Therefore we regret that only two delegates from Austria were able to attend the Congress and the more, as many items dealt with were of particular interest for the geological research in Austria.

The Eastern Alps with their stratigraphy and tectonics as well as the Upper Tertiary Basin of Vienna with its oil deposits are classical regions for the study of each structure, and I rejoice to say that we are able to work, in spite of all difficulties.

I am most pleased to be able to say that we have many friends among the geologists of the world and I take this opportunity to deliver best greetings from Austrian geologists, to you all.

The excellent preparations, the organization and the marvellous British hospitality have resulted in the complete success of the Congress. In the name of the Austrian delegation I have the honour to express to the Organizing Committee our most sincere thanks."

Dr. L. Cepek (Czechoslovakia):—

"At the end of the work of this Congress, the Czechoslovak delegation want to say what a very special pleasure the Congress has been for us, who have been cut off from the world for so many long years. The work and discussion of the universal family of geologists show the spirit of international co-operation and agreement. The more co-operation, the nearer we shall be to the peace which we all need so much for our work.

We thank Great Britain for its hospitality and the Organizing Committee for its excellent organizing work. We thank the British geologists and all people who helped them to realize this pleasant session of the International Geological Congress in London."

Dr. R. Fabiani (Italy):—

"Ho l'onore di esprimere al Governo di Sua Maestà la gratitudine del Governo d'Italia per il grazioso invito a partecipare al diciottésimo Congresso Geologico Internazionale.

All'Onorevole Presidenza del Congresso al Senato dell'Università, ai Comitati Direttivi del British Museum of Natural History, dell'Istituto di Archeologia, della Società Geologica di Londra e dell'Istituto del Petrolio porgo i più vivi ringraziamenti per la cordiale accoglienza, i gentili inviti e tutte le facilitazioni favoriteci. E questo a nome di tutti i delegati italiani e delle Istituzioni Scientifiche, Consiglio Nazionale delle Recerche, Accademia dei Lincei, Accademia dei XL, Società Geologica Italiana, Università ecc. da essi qui rappresentati. Ai Colleghi tutti e più particolarmente a quelli nati nella Terra di William Smith, di Murchison, di Charles Lyell—pioneri gloriosi delle Scienze Geologiche—giunga gradito il cordiale saluto di commiato dei Colleghi venuti dal Paese di Leonardo da Vinci.

E alle felicitazioni per i brillanti e fecondi risultati di questa grande riunione, vogliamo infine aggiungere il fervido augurio che i geologi di tutto il mondo, in nobile gara per un sempre maggiore progresso della Scienza a beneficio dell'Umanità, sappiano stringere ognor più i vincoli fra tutti i popoli, sicchè anche per noi geologi possa esprimersi coi cinque simbolici cerchi fra loro congiunti delle Olimpiadi il legame spirituale fra i cinque Continenti."

Professor H. A. Brouwer (Netherlands):—

"On behalf of the representatives of the Netherlands, from where perhaps the greatest number of geologists in comparison to the size of the country has come to this Congress, I have all the more reason to offer our heartiest thanks to the British Government and to the Organizing Committee for the excellent way in which they have faced the difficulties that were connected with the rehabilitation of the International Geological Congress, after a long and forced interruption.

A large number of new geological studies have made the session a great success and it was pleasant to see that geologists can differ and still be friends. The excursions enabled us to see a very wide range of geological phenomena of which many were known to us by reputation, as they are famous in the history of our science.

There have been for us frequent opportunities in the past to come to this country, and it was a pleasure for us to have this reason to visit it again; we find that whatever may have changed in the world in all those years, your great kindness and hospitality have remained *unchanged*.

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We are also much impressed by the fact that many English Congress members have withdrawn their papers in order to give all the time available to their foreign visitors.

It is a pleasure to congratulate the Organizing Committee on their success and to express our warmest thanks for the cordial reception that has been extended to us.

It has been a great pleasure to participate in the Eighteenth Session of the International Geological Congress, and I am sure that we shall look back to these days as exceptionally pleasant and successful."

Senhor J. B. Bebianio (Portugal):—

"On behalf of the Portuguese delegation I have the pleasure of associating myself with the words of appreciation and of thanks expressed by the previous speakers concerning the splendid organization and the result achieved by this Congress, as well as for our cordial reception.

When we notice that scientists from so many countries have left their homes to be present at this gathering, we must conclude that the spirit of co-operation is abroad in the world.

Further, such gatherings show that Governments and private institutions both realize the importance of geology in the resolution of many problems of practical interest to mankind.

Besides, the success of such meetings shows that geologists are always willing to help when they are called.

As visitors we are glad to notice that Britain is well on the way to recovery from her war-time trials, and we hope that such recovery will speedily be completed."

Dr. Per Geijer (Scandinavia):—

"Mr. President, Ladies and Gentlemen,

I have the honour to speak for the members attending this Congress Session that represent a group of countries by themselves called the North, that is: Denmark, Finland, Iceland, Norway and Sweden. Just as we are used to a very close co-operation in working out our common problems of regional geology, as in other phases of scientific activity, so we feel that what we wish to say here to-day can be said by one, voicing the feelings of all of us.

We wish to express our most sincere gratitude towards the Government of Great Britain, at whose invitation this Session is being held, towards you, Mr. President, and every other British geologist who, as a committee member, as a secretary, a director of excursions or in some other capacity has contributed to the preparations for this Session or to its carrying through to the splendid success it has proved. I feel that, in saying this, I can speak also for those, less fortunate than ourselves, who have not been able to attend this Session, but who are going to profit from it when we return with our impressions, our collections and the valuable publications that have been issued for the Congress Session.

We thank you, we congratulate you, and we wish you the same well-deserved success for the excursions that form the remaining part of the programme."

Dr. J. G. Siñeriz (Spain):—

"Senores, después de dirigir un respetuoso saludo á todos los presentes, tengo el deber, que cumplo muy guston, de expresar en nombre de la Delegación española y en el del Instituto Geológico y Minero de España, la gratitud que sentimos hacia las Autoridades civiles y científicas de Londres, por las múltiples atenciones de que nos han hecho objeto y muy especialmente a los senores Presidente y Secretario de la Comision organizadora del Congreso, así como a los miembros de le misma.

Gracias á la perfecta organización lograda, se ha podido realizar, con éxito completo, un trabajo que, de otra manera, hubiera sido abrumador, contribuyendo muy eficazmente al progreso de la ciencia geológica universal y de las demás que, como la prospeccion geofisica, están intimamente relacionales con aquellos quiero tambien aprovechar esta ocasión para dirigir un cordial saludo á todos los colegas representantes de la ciencias geológicas que se cultivan en todo el mundo y para desear que, al volvernos á reunir en el Congreso de Argel, todos disfruten de buena salud y

así pueden contribuir con su trabajo á que el éxito que obtengan sea, por los menos, comparable al obtenido en el que se clausura en estos momentos.”

Professor L. W. Collet (Switzerland):—

“I am joining with the former speakers in thanking you, Mr. President, for this splendid Congress, to which Swiss geologists have come in unusual numbers. A great number of them are former or present geologists of oil companies of your kingdom.

I thank you very much for the splendid hospitality you have given them for almost 50 years. Not only do Swiss geologists like British geologists, but the people of both Switzerland and Britain like one another. Why?

Like you we love tradition, sport, exploration; and in Great Britain we all have found inspiration, we have learned to be up and doing every day our best, to be not only men of thought, but also men of action.

The Swiss geologists have received in Great Britain a present of the greatest value for a man: the spirit of Britain.”

Professor R. Kozłowski (Poland) also communicated to the Congress a message of thanks and good wishes from his delegation.

Professor L. Lutaud (France):—

“Monsieur le Président, Mesdames, Messieurs,

En prenant la parole à la suite des Chefs des différentes délégations venues ici de l'Etranger, je me trouve en quelque sorte à court de mots pour renouveler la forme des remerciements qui ont déjà été adressés à la Société géologique de Londres, au Comité d'organisation et au Bureau du Congrès, à tous les conducteurs d'excursions, à tous les organismes et à toutes les Sociétés qui nous ont si magnifiquement accueillie, au Gouvernement de Sa Majesté enfin, qui a bien voulu consacrer notre présence en Grande Bretagne.

Mais s'il y a des paroles qu'il est permis de répéter avec force et d'entendre à nouveau avec plaisir, ce sont bien celles qui doivent exprimer en ce jour notre reconnaissance et notre admiration.

La réussite splendide de notre Dix-huitième Session est due au travail acharné, à la méthode impeccable, au dévouement sans limites de nos collègues de Grande Bretagne qui n'ont mesuré ni leur temps, ni leurs efforts: à tous points de vue, ce Congrès tenu à Londres a été un très grand succès et restera un exemple.

Au nom de la Délégation française et de celles venues de l'Union française, je tiens donc à m'associer avec chaleur aux remerciements et aux sentiments de gratitude qui ont déjà été exprimés. Et me tournant vers le Bureau, qui a droit tout particulièrement à notre reconnaissance, je lui demande de donner à chacun la part qui lui revient, de n'oublier aucun de ceux qui ont collaboré à un titre quelconque à la bonne marche du Congrès, et de remercier notamment le personnel du *Registry*, dont nous avons pu apprécier le dévouement et l'inlassable gentillesse.

S'il m'est permis d'insister sur un point particulier, je dirai que ce que j'ai rencontré de plus précieux ici, c'est la cordialité si grande et si simple de l'hospitalité qui nous a été offerte: elle a imprimé sa marque sur la tenue générale du Congrès.

Les géologues cependant n'ont pas toujours la réputation d'être d'humeur facile: ils disputent volontiers et se disputent quelquefois avec véhémence. Mais ce sont tout de même des hommes de bonne volonté qui recherchent de leur mieux la vérité. Ils forment dans le monde une famille unie, par un amour commun, celui de notre vieille maman, la Terre. Et puisque des géologues peuvent arriver, dans une rencontre comme celle-ci, à s'entendre, à se retrouver avec joie et à s'aimer, nous avons le droit de penser, d'espérer, d'être certains que tous les hommes sur terre peuvent et doivent en faire autant.

Parlant le dernier, j'en ressens aujourd'hui pour mon Pays un honneur particulier. En effet, à la suite de ce Congrès tenu à Londres, la Grande Bretagne se prépare à nous remettre le flambeau que nous nous transmettons, à chaque Session, pour poursuivre notre course scientifique vers le progrès. Vous nous avez fait le grand honneur d'accepter l'invitation que je vous ai présentée, au



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nom de la France, de tenir notre prochaine Session dans l'Afrique du Nord, à Alger. C'est donc à notre tour de prendre en mains la tâche qui incombe à nos Congrès et nous représentons en quelque sorte aujourd'hui l'Avenir: nous vous remercions de votre confiance.

Cet honneur implique un grand devoir, que nous nous efforcerons de remplir dignement. C'est de grand cœur que nous vous avons invités et j'espère que vous viendrez très nombreux à Alger, où nous aurons à vous montrer et à soumettre à votre discussion l'importants et très beaux problèmes géologiques. Je pense que vous ne regretterez pas votre voyage même si, dans cette région si attrayante et si instructive, il ne nous est pas possible évidemment de vous offrir toutes les splendeurs de Londres."

### 4. The President then spoke as follows:—

"Members of the Eighteenth Session of the International Geological Congress,

I am personally overwhelmed as all British geologists must be overwhelmed by the sentiments expressed by the delegates who have just spoken. I extend to them all our gratitude for their kindness to us. They have, I feel, in this their kindness overlooked our shortcomings, but I am very content that it should be so. Friends, I cannot adequately express to you what I feel—I can only say: I thank you all.

I am glad to be able to thank the great institution, the mother of geological surveys, which has contributed so considerably to the success of this gathering. I thank Dr. McLintock, the Director of His Majesty's Geological Survey, for permission to use the Geological Survey and Museum for our Headquarters, for his ready assistance in countless and often unexpected ways, and for his unfailing advice in the organization of this meeting. To his staff I extend your thanks for their unceasing labours, these for the most part carried out in unofficial hours. To all those from Universities and from other bodies who have helped us, especially with excursions, I express my gratitude; they are too numerous to name, but will they kindly take this as directed to them both individually and specially? From this great body of helpers I feel I must select a few for mention by name.

Mr. Ashcroft, our Treasurer, has worked ceaselessly for many months and I wish him a well-earned but, I am afraid, temporary rest from his labours. On behalf of the Assembly I would like to offer our felicitations to Mr. Ashcroft on his seventieth birthday. Dr. Mitchell has never lost his way in the intricacies of the excursion arrangements. Professor Hawkes has given invaluable assistance in the academic work of the Secretariat. To these and to all those whom I cannot name ranged behind them, I extend our grateful thanks.

And now I come to my final expression of thanks. The success of this Session has depended in an unbelievable degree on one man—Mr. A. J. Butler. There has, I am sure, never been a Session so well and minutely organized as this. I have heard of no single detail which has not been considered and the results are apparent in our comfort as well as in our success. For all this Mr. Butler is primarily responsible. I thank him on behalf of the Congress, but I also wish to ask him and Mrs. Butler to accept from my heart my deepest personal gratitude for all that has been done to make my task so easy and so pleasant. Never before can a President have been so tactfully guided, cared for, nourished, groomed and presented as I have been. I express to you, my dear Butler, my sincere gratitude.

At the inaugural Meeting last Wednesday Professor Belousov handed to me the geological torch that had been lit at the Seventeenth Session in Moscow, and I hope to be privileged to hand it on to my successor at the Nineteenth Session in Algiers in 1952. I feel that this London Meeting has given a magnificent brilliance to that torch that shall never be diminished.

Before this Session closes I will ask Professor Renier of Belgium to present to you one last proposal."

Professor A. Renier (Belgium):—

"Parmi les dixsept cent cinquante inscrits à la présente session du Congrès géologique international, il en est qu'un, un seul, qui ait participé à sa première session, celle tenue à Paris en 1878.



Agé alors de seize ans, étant né en 1862, le 11 novembre, en la fête de la Saint Martin, ce membre fut impressionné par cette réunion scientifique à un point tel qu'il a consacré sa vie à promouvoir à sa façon les sciences géographiques et géologiques. Sa traduction en langue française de " La Face de la Terre " d'Eduard Suess est, de longue date, comme universellement sans repit, il a facilité la publication de textes et de cartes de toute sorte.

J'ai l'honneur et le plaisir de proposer l'envoi du message suivant à M. Emmanuel de Margerie:—

A l'instant de la clôture de sa dix-huitième session, le Congrès géologique international, dont vous êtes membre depuis son début, vous prie d'agréer l'expression respectueuse de sa reconnaissance et de ses félicitations pour votre carrière scientifique."

*The proposal was adopted by general acclamation.*

The President then spoke finally:—

" Members of the Eighteenth Session, we are now about to separate. I wish you all good fortune for a continuing pleasant stay in our country and a safe return to your own places. I declare this Eighteenth Session of the International Geological Congress to be closed."

# PROCEEDINGS OF THE COUNCIL

A series of Council Papers were distributed to members of the Council before the first meetings, together with Agenda Papers. Versions in each official language were available. The English version of the Council Papers is given below. The Agenda Papers are not reprinted, since the Minutes of the Council contain a full account of its proceedings.

## Council Paper 1

### GENERAL PROCEDURE AT THE MEETINGS OF THE COUNCIL

**M**EMBERS of the Council will realize, from the Agenda Papers which are attached, that the Council has a great deal of business to transact. Also it will not be easy, without affecting the convenience of Members of the Council and trespassing upon the time allotted to technical meetings and excursions, to arrange Council Meetings in addition to those already presented in the printed Programme of the Session.

The Executive Committee has therefore attempted in this series of Council Papers to give adequate explanation of the main items of the Agenda, and to make suggestions for their treatment. It is hoped that these Papers will save much time which would otherwise be necessarily occupied by verbal explanation.

*All Members who take part in the discussions of the Council are most earnestly requested to speak very briefly.*

On rising to speak each Member should first clearly announce his name and his country.

### INTERPRETATION

The interpreters will give:—

- (a) *As routine.* A version or summary in English of each speech delivered in French.  
A version or summary in French of each speech delivered in English.  
Versions or summaries in both English and French of each speech delivered in German, Italian or Spanish.
- (b) *On request by any Member.* A version or summary in German, Italian or Spanish of a speech delivered in any official language.

## Council Paper 2

### PROPOSALS FOR MEMBERSHIP OF THE COUNCIL, UNDER PARAGRAPH 2 OF ARTICLE IX OF THE STATUTES, AND VOTING PROCEDURE AT COUNCIL MEETINGS

The total number of official Delegates appointed in response to invitations from the General Organizing Committee is over 400. It should also be noted that some institutions and societies have appointed as many as ten or twelve delegates, others only one or two; and that on the other hand there are a number of cases in which one Delegate represents several institutions.

At some previous Sessions various special procedures have been adopted in order that the Membership of the Council should not be too large for the efficient conduct of business. At the Fifteenth Session in South Africa *no* Delegates of Societies and Institutions were included in the Council, which therefore consisted only of Delegates of Governments together with certain persons nominated under paragraphs 1 and 3 of Article IX of the Statutes. At the Sixteenth Session in Washington, paragraph 2 of Article IX was interpreted to mean that Societies and Institutions were to be represented by only one Delegate. At some other Sessions it appears that no such restriction of numbers was made.

## COUNCIL

The General Organizing Committee proposes the following procedure as a fair and reasonable arrangement:—

### *Preliminary Meeting*

That *all* official Delegates appointed in response to invitations shall rank as Members of the Council and are invited to attend the Preliminary Meeting. (By this means the status of all Delegates will be recognized.)

### *Subsequent Meetings*

That all *Delegates of Governments* shall be entitled to attend all Council Meetings, if they so wish. That in any case where a particular institution, geological survey, society or university has appointed more than *one Delegate*, its Delegates be requested to arrange, by mutual consultation, that only one of their number shall attend any one meeting of the Council as representative of that particular institution.

(By this means the size of the meetings will be reduced and business will be expedited; and many Delegates can by mutual arrangement be freed to join excursions or attend other meetings.)

### *Voting Procedure*

That where a vote is taken at a Council Meeting each Member present shall have one vote; that a proposal not affecting the Statutes shall be considered carried if a *simple majority* of the members present vote in favour; and that a proposal under Article XII of the Statutes shall be considered carried if *two-thirds* of the members present vote in favour.

(By this means proposals placed before the Council will have a fairer opportunity of being agreed than if a simple majority or a two-thirds majority of the whole membership of the Council be required; for however the Council be composed it is unlikely that all members will be able to attend any particular meeting.)

## Council Paper 3

### COMMISSIONS OF THE CONGRESS

A list of the existing Commissions of the Congress and of their membership is attached.\*

Some of the members of these Commissions are deceased and a considerable number of others cannot attend the Session.

It is proposed to hold a joint meeting at 9 a.m., on Thursday, August 26th, in the building of the Royal Geographical Society, of all members of these Commissions who are present at the Session and of any persons who have been commissioned to act for absent members of the Commissions or have similar special interest in the work of the Commissions. The President will take the Chair.

It is hoped that a preliminary report on the state of the Commissions may thus be assembled; and that the members of each Commission which wishes to proceed with its work will then arrange future meetings at times mutually convenient to them.

It will not be necessary for members of the Commission on the Geological Map of Africa to attend this meeting, since special meetings of the Association of African Geological Surveys have already been arranged.

## Council Paper 4

### PROPOSAL TO SET UP A TEMPORARY COMMISSION TO REPORT ON PROBLEMS CONNECTED WITH THE PLIO-PLEISTOCENE BOUNDARY

Professor W. B. R. King and Dr. K. P. Oakley, Chairman and Secretary of Section H.—The Plio-Pleistocene Boundary—propose that a Temporary Commission be set up, to work during the Session

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\*This list, compiled from the Report of the Seventeenth Session, is not reproduced here.

## PART I: GENERAL PROCEEDINGS

in connection with the proceedings of Section H. The Commission would report to the Council at the close of the Session and would then dissolve. The following terms of reference are proposed:—

“To examine the various methods and schemes which have been used to define the Pliocene-Pleistocene Boundary, and to report thereon to the Council at the end of the Eighteenth Session with recommendations regarding future use of the existing nomenclature and other relevant matters.”

It is proposed that the following be members of the Commission, with powers to add to their number if they wish:—

Professor C. Arambourg  
Professor P. G. H. Boswell  
Dr. F. Florschütz  
Dr. A. T. Hopwood  
Dr. L. S. B. Leakey

Professor C. I. Migliorini  
Mr. Hallam L. Movius, Jr.  
Professor J. Piveteau  
Professor I. M. van der Vlerk  
Professor F. E. Zeuner

### Council Paper 5

#### PROPOSAL FOR THE ESTABLISHMENT OF A COMMISSION OF THE INTERNATIONAL GEOLOGICAL CONGRESS, EIGHTEENTH SESSION, TO CONCERN ITSELF WITH THE PREPARATION OF A WORLD PHYSIOGRAPHIC PROVINCE MAP

Presented by Dr. LOUIS L. RAY

The broad regional relationship between landforms, bedrock types and structure, and geomorphologic development are strikingly shown by physiographic province maps. From such maps, earth features can be correlated and related to past earth-shaping events.

The Physiographic Province Map of the United States, published by the United States Geological Survey, has become a classic for the understanding of the regional geology and geomorphic development of this country.

It is proposed that an international physiographic province map of the world be prepared by local geologists under a Commission established by the International Congress. Such a map, in conjunction with geologic maps, will aid in the understanding of the earth's surface features and the interpretation of its dynamic and geomorphic development.

NOTE.—The Executive Committee suggest that after Dr. Ray has presented this proposal he be invited to arrange a special meeting of members interested in the project; and thereafter to report the opinion and result of that meeting to the Council.

### Council Paper 6

#### PROPOSAL THAT THE CONGRESS SHALL ATTEMPT TO PROMOTE INTERNATIONAL CO-OPERATION IN THE WORK OF ACCURATE CHEMICAL ANALYSIS OF METEORITES

Presented by Professor WALTER WAHL

In recent years the question of the chemical composition of the Meteorites is again gaining more attention, since its importance both with regard to the problem of the constitution of the earth and the recent development of atomic physics has been realized. I shall here only refer to the papers by Daly, “Meteorites and an Earth Model” (*Bull. Geol. Soc. Amer.*, 1943, pp. 401-456) and by Harrison Brown and Cl. Patterson, “The Composition of Meteoric Matter I-III” (*Journ. Geol.*, 1947, pp. 405-411, and 508-510, and 1948, pp. 85-111).

With regard to iron meteorites several important researches dealing with the matter from a metallographic standpoint have recently been published (by Stuart Perry, Mehl, Owen and others).



## COUNCIL

Unfortunately a great number of the analyses of the stony meteorites are very old or made according to unsatisfactory methods. Also a number of recently published analyses are not satisfactory. The analyses of meteorites have in many cases been made as occasional work by chemists who have not had a sufficient experience in work of the difficult kind required in such cases.

In those calculations on the average composition of meteoric matter which so far have been published, all analyses of stony meteorites, good as well as inferior, have been used. These results are much influenced by certain probably entirely wrong analyses and no exact knowledge of the composition of meteorites will be available before new analyses have been made of a number of the stony meteorites. It is necessary to obtain trustworthy analyses for each of the more important groups of stony meteorites and then calculate a weighted average composition taking into consideration the frequency of falls of the different kinds of meteorites. Out of 755 stony meteorites known in 1940 about 120 were unclassified and only about 110 analysed. These figures show that a certain amount of organization is necessary in order that we should be able to obtain better knowledge of the chemical composition of meteoric matter.

Meteorites are precious museum objects, which are not easily obtainable for research. There are also very few analytical chemists sufficiently trained for such work. The question therefore arises, could a body like a Geological Congress, or a Commission appointed by the Congress, further or sponsor such work to be done. The location of the material in the museums of different countries and the fact that the material in many cases is almost entirely in the possession of some single museum, also points towards the importance of international co-operation in this case.

NOTE.—The Executive Committee suggests that a small committee be appointed to consider this letter, consulting with any other Members as they wish, and thereafter to report back to the Council at its meeting on August 30th.

### Council Paper 7

#### RECOMMENDATION BY THE NETHERLANDS GEOLOGICAL AND MINING SOCIETY CONCERNING THE DEFINITION OF THE PLEISTOCENE-HOLOCENE BOUNDARY

Presented by the President of the Society, Dr. H. M. E. SCHÜRMANN

-7000	Boreal	Ancylus Lake	Dry and gradually rather warm	Postglacial	Forests of <i>Pinus</i> , <i>Corylus</i> , <i>Alnus</i> , <i>Quercus</i> , <i>Tilia</i> , <i>Ulmus</i>	Mesolithic	Holocene
	Preboreal	Yoldia Sea		Bipartition	First appearance of <i>Quercus</i> , <i>Tilia</i> , <i>Ulmus</i>		
-8000				Finiglacial			
-9000	Subarctic	Baltic Ice Lake	Tjale	Mid-Swedish Terminal Moraines	Forests of <i>Pinus</i> , <i>Betula</i> , <i>Salix</i>	Epipalaeolithic	Pleistocene
				Gothiglacial			

## PART I: GENERAL PROCEEDINGS

It is desirable to arrive at an agreement concerning a suitable separation of the Holocene from the Pleistocene. There is still a certain divergence of opinion among geologists, archaeologists and palaeobotanists engaged in the study of the latest chapter of the earth's history. However, in recent years a tendency has been observed to accept for this purpose the beginning of preboreal conditions. Corresponding with this point of time (8,000 B.C.) the transition between epipalaeolithic cultures and the first appearance of *Quercus*, *Tilia*, *Ulmus*, *Corylus* has been generally established in Northern, Western and Central Europe.

The Netherlands Geological and Mining Society makes the suggestion that this demarcation line should be indicated by the International Geological Congress as marking the beginning of the Holocene Period.

NOTE.—The Executive Committee finds that British botanists, archaeologists, and geologists interested in this question consider that further research is advisable before a rigid definition of the Pleistocene-Holocene boundary is agreed.

The Committee therefore suggests that the Council shall recommend the definitions proposed above as being worth the consideration of botanists, archaeologists and geologists, but shall not at present indicate that it accepts the definition as final.

### Council Paper 8

#### PROPOSAL BY THE NETHERLANDS GEOLOGICAL AND MINING SOCIETY CONCERNING JOURNALS OF ABSTRACTS

The Society suggests that the Congress should attempt to arrange for the revival of the *Geologische Jahresberichte*, the *Geologisches Zentralblatt* and the *Revue de Géologie*.

NOTE.—The Executive Committee suggests that the Council should accept the principle of this proposal, and should instruct and authorize the Bureau of the Congress to investigate the possibility of reviving these journals, or of promoting some alternative form of abstracting service for geology.

### Council Paper 9

#### RECOMMENDATION FROM THE SOCIETY FOR THE PROMOTION OF NATURE RESERVES CONCERNING THE ESTABLISHMENT OF NATIONAL GEOLOGICAL RESERVES

Presented by Dr. G. F. HERBERT SMITH

Honorary Secretary of the Society

In many countries important geological features and type-sections of strata are in constant danger of being destroyed or rendered inaccessible by operations or developments undertaken by government departments, local authorities, commercial firms, or private individuals. Damage is often done inadvertently, and it is therefore important that those concerned with the use of the land should know of these features. Delegates are accordingly advised to prepare or cause to be prepared lists of geological sites of outstanding scientific or educational importance in their several countries, and to urge their governments to undertake legislative measures for safeguarding these sites and for securing reasonable access to them.

In some countries the initial steps have already been taken. In England and Wales, for instance, a list of the important geological sites is given in the report by the Geological Sub-Committee of the Nature Reserves Investigation Committee in their report on *National Geological Reserves in England and Wales* (Memorandum No. 5, Society for the Promotion of Nature Reserves, London, 1945) and largely repeated in the report of the Wild Life Conservation Committee of the Ministry of Town and Country Planning on *Conservation of Nature in England and Wales* (H.M. Stationery Office, CMD. 7122, 1947). It is understood that His Majesty's Government has accepted these recommendations in principle.

## NOTES ON THE QUESTION OF FORMING AN INTERNATIONAL UNION OF GEOLOGY

1. There exist, for many sciences, international unions which are affiliated in a central council, the International Council of Scientific Unions. Examples are the International Union of Geodesy and Geophysics, the International Biological Union and the new International Union of Crystallography.
2. The constitutions of these unions vary in detail, but all have a fundamental common pattern: each country to be represented in a particular scientific union sets up a national committee for the science concerned; these committees send delegates to an assembly of the union; and the assembly of delegates elects a smaller international executive body whose members remain in office for a defined period.
3. The chief aim of each union, broadly and simply, is to further international co-operation in its science.
4. Each country represented in a union contributes, through its national committee, to the funds of the union.
5. A proposal to form an International Union of Geology was discussed at the Thirteenth Session of the International Geological Congress held at Brussels in 1922. The proposal was rejected. It appears that the Council of that Session did not consider that the formation of a Union would usefully supplement the existing functions of the Congress.
6. UNESCO and the International Council of Scientific Unions have recently made a mutual agreement whereby UNESCO turns to the International Council and to its existing affiliated Unions for scientific advice; and whereby UNESCO may grant funds to the International Council or affiliated Unions for the prosecution of scientific projects of international importance. UNESCO has expressed the hope that an International Union of Geology may be formed and affiliated with the International Council of Scientific Unions, so that there may be a permanent international geological executive to which UNESCO may turn for advice and with which it may co-operate.
7. During the organization of the Eighteenth Session a number of geologists in several countries, having particularly in mind the new factor mentioned in paragraph 6 above, have suggested that the question of forming a Union of Geology should again be considered. The Executive Committee has therefore placed it on the Agenda of the Council.
8. British geologists who have discussed this question will be content to accept the decision of the Council as a whole, whether it be favourable or adverse to the formation of a Union. But should the Council favour in principle the formation of a Union, British geologists will suggest that the Council should accept the following points:—
  - (a) That the Constitution of the Union shall be quite separate from and shall in no way affect the Statutes of the Congress. (They consider that in the heavy and complicated task of organizing a Geological Congress and its associated excursions complete responsibility and control should rest in the country which is host.)
  - (b) That the Constitution of the Union should be of the maximum simplicity compatible with its acceptance by the International Council of Scientific Unions; and that its simple purpose should be to institute a small permanent international geological executive body which can advise and work with UNESCO.



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9. To facilitate discussion a skeleton set of Statutes and Rules for a Union has been drafted, in accordance with 8(a) and (b) above, and a copy is attached. A Constitution of this type appears to be acceptable to the International Council of Scientific Unions.
10. After the matter has been discussed by the Council, the President will ask the Council to indicate by vote whether it approves in principle the formation of a Union.
11. If the principle of the formation of a Union be approved, it is suggested that the Bureau, in liaison with the International Council of Scientific Unions, be asked to promote the formation of a Union.

## SKELETON STATUTES AND RULES OF AN INTERNATIONAL UNION OF GEOLOGY

### OBJECTS OF THE UNION

1. The objects of the Union are:—
  - (a) To promote the study of geological problems.
  - (b) To facilitate international co-operation in geology.
2. The Union is a member of the International Council of Scientific Unions.

### MEMBERSHIP

3. Each country may adhere to the Union through its national academy, national research council or its Government acting through a national committee representing geology in that country.

### ADMINISTRATION

4. The work of the Union shall be directed by the General Assembly of the delegates appointed by the National Committees.  
(Details of rules governing voting and calculation of dues from national organizations to be inserted here.)
5. The Officers of the Union elected by the General Assembly are: a President, two Vice-Presidents, a General Secretary, a Treasurer and four other members.
6. These Officers constitute the Executive Committee of the Union. They hold office until the close of the Ordinary General Assembly following that at which they were elected.
7. The President and Vice-Presidents are not eligible for re-election to the same office, but other officers are immediately eligible for re-election.

### ASSEMBLIES

8. An Ordinary Meeting of the General Assembly of the Union shall normally be held every three years, during successive sessions of the International Geological Congress.  
(Details concerning extraordinary meetings, agenda to be transacted, etc., to be inserted here.)
9. The Executive Committee of the Union shall present a report of its activities at meetings of the General Assembly.

### COMMISSIONS

10. The Executive Committee of the Union shall do all in its power to assist the work of the Commissions of the International Geological Congress.

### INTERNATIONAL GEOLOGICAL CONGRESS

11. Close liaison shall be maintained between the Union and the Bureau and General Organizing Committee of the International Geological Congress.



# Preliminary Meeting of the Council, 8-30 p.m. on Tuesday, August 24th

Professor V. V. Belousov (U.S.S.R.), representing the late President of the Seventeenth Session, was in the Chair.

Two hundred and seventy-two Members were present.

Mr. A. J. Butler, General Secretary, introduced and welcomed Professor V. V. Belousov, Head of the Delegation of the U.S.S.R.

## 1. CHAIRMAN'S WELCOME TO THE COUNCIL

The Chairman, in welcoming the Council, explained that, owing to the absence because of illness of his colleague, it had fallen to his lot to have the honour of taking the place of the late President of the Seventeenth Session and of announcing the opening of the work of the Eighteenth Session of the International Geological Congress.

On behalf of the numerous geological institutions and societies of the Soviet Union and all Soviet geologists, he extended greetings to the Congress. He was convinced that the work of the Congress would be harmonious and successful; this was ensured by the excellent organization of the Session and the hospitality which had been shown to the Congress both in arranging the Session and in organizing the extremely interesting and instructive excursions which many delegates had enjoyed.

With those brief remarks, it was his privilege to declare open the Preliminary Meeting of the Council of the Eighteenth Session of the International Geological Congress.

## 2. BUREAU OF THE EIGHTEENTH SESSION

The Chairman asked the General Secretary of the General Organizing Committee to present the proposed composition of the Bureau of the Eighteenth Session.

Mr. A. J. Butler, General Secretary, presented the following proposals for the composition of the Bureau:—

PRESIDENT	...	...	Professor H. H. Read (President of the General Organizing Committee).
GENERAL SECRETARIES	...		Mr. A. J. Butler, Professor L. Hawkes (General Secretaries of the General Organizing Committee).
VICE-PRESIDENTS	...		The Head of each Government Delegation. Mr. F. N. Ashcroft, Treasurer of the General Organizing Committee. Sir Edward Bailey, Honorary Member of the General Organizing Committee. Professor O. T. Jones, Foreign Secretary of the Geological Society of London.

The Chairman asked the Council to approve the proposed composition of the Bureau.

*The proposal was approved by acclamation.*

*(The President-Designate, Professor H. H. Read, then took the Chair.)*

## 3. GENERAL PROCEDURE AT THE MEETINGS OF THE COUNCIL (COUNCIL PAPER 1)

Professor H. H. Read, Chairman, after thanking the Council very sincerely for the great honour it had done him in electing him President, asked the meeting to note the contents of Council Paper 1, which set out general proposals for the conduct of the meetings of the Council. He hoped the meeting would agree with the general purport of Council Paper 1.

*The Council took note of Council Paper 1.*

## 4. PROPOSALS FOR MEMBERSHIP OF THE COUNCIL UNDER PARAGRAPH 2 OF ARTICLE IX OF THE STATUTES: AND FOR VOTING PROCEDURE AT COUNCIL MEETINGS (COUNCIL PAPER 2)

The Chairman, in putting Council Paper 2 to the meeting, said that at earlier Sessions of the Congress there had been various different arrangements for the constitution of the Council. The

## PART I : GENERAL PROCEEDINGS

General Organizing Committee recommended the procedure which was set out in Council Paper 2 for the present Session. That procedure was considered to be consistent with Article IX of the Statutes. He invited comments or suggestions on the proposed procedure.

Mr. E. J. Wayland (Bechuanaland, Basutoland and Swaziland) said that, without wishing to go against any previous procedure, it nevertheless seemed to him that a Council composed of so large a number would be unwieldy. Several countries had more than one delegate at the Congress, and he suggested that it would facilitate the proceedings and relieve the congestion if only one delegate from each country were a member of the Council.

Mr. A. J. Butler, General Secretary, agreed that the Council was a large one and that it might be difficult to transact business in a Council consisting of so many members; but the Statutes specifically prescribed that, in addition to the Government delegates, there should be at least one representative from any institution, university or similar body whose delegates were present at the Session. The General Organizing Committee had felt that for the present Session, which was taking place after so long an interval, it might be useful to have a large and widely representative Council. Problems requiring detailed technical consideration could be delegated to small committees or commissions.

Professor V. V. Belousov (U.S.S.R.) supported the proposals in Council Paper 2 and pointed out that the body suggested by Mr. Wayland already existed as the Bureau of the Congress.

Sir Lewis Fermor (Great Britain) suggested that, whichever of the two methods of limiting the number of the Council were adopted, that limitation should not apply to the fourth meeting of the Council, at which it would receive the reports of the Commissions of the Congress.

There was no seconder for Mr. Wayland's proposal.

*The proposals in Council Paper 2 were approved, with one dissentient.*

### 5. COMPOSITION OF THE COUNCIL

Mr. A. J. Butler, General Secretary, presented the following proposals for the composition of the Council:—

*Members under paragraph 1 of Article IX of the Statutes:*

Dr. K. C. Dunham

Dr. G. H. Mitchell

Professor W. G. Fearnside

Dr. C. J. Stubblefield

Dr. G. M. Lees

Professor Alan Wood

*Members under paragraph 2 of Article IX of the Statutes:*

All official delegates appointed in response to invitations from the General Organizing Committee.

*Members under paragraph 3 of Article IX of the Statutes:*

Mr. C. H. Dinham

Dr. K. S. Sandford

In putting forward these proposals, Mr. Butler reminded the meeting that paragraph 3 of Article IX of the Statutes permitted the Council to co-opt supplementary members if it saw fit to do so.

*The proposals were approved.*

The General Secretary announced that arrangements had been made for various national delegations to meet in the Members' Lounge after the Council Meeting in order that they might arrange their representation at subsequent Council Meetings.

### 6. SECTIONAL MEETINGS OF THE SESSION

The Chairman asked the General Secretary to present proposals concerning the first Chairmen and permanent Secretaries of the Sectional Meetings of the Session.

Professor L. Hawkes, General Secretary, in presenting the proposals, said that it was proposed that the Secretaries should function throughout all the meetings of their respective Sections, but that

## COUNCIL

the members present at the meetings of each Section should be empowered to elect subsequent Chairmen. The names proposed were as follows:—

SECTION	CHAIRMAN	SECRETARY
A. Problems of Geochemistry ... ..	C. E. Tilley	S. R. Nockolds
B. Metasomatic Processes in Metamorphism ...	A. Holmes	Doris Reynolds
C. Rhythm in Sedimentation ... ..	W. G. Fearnside	P. Allen
D. The Geological Results of Applied Geophysics ... ..	W. F. P. McLintock	J. McG. Bruckshaw
E. The Geology of Petroleum ... ..	V. C. Illing	G. D. Hobson
F. The Geology, Paragenesis and Reserves of the Ores of Lead and Zinc ... ..	W. R. Jones	K. C. Dunham
G. The Geology of Sea and Ocean Floors ...	O. T. Jones	W. B. Harland
H. The Plio-Pleistocene Boundary ... ..	W. B. R. King	K. P. Oakley
J. Faunal and Floral Facies and Zonal Correlation ... ..	A. E. Trueman	H. Dighton Thomas
K. The Correlation of Continental Vertebrate-bearing Rocks ... ..	D. M. S. Watson	W. E. Swinton
L. Earth Movements and Organic Evolution ...	H. L. Hawkins	F. Hodson
M. Other Subjects ... ..	E. B. Bailey	R. M. Shackleton

*The proposals were approved.*

### 7. COMMISSIONS OF CONGRESS (COUNCIL PAPER 3)

The Chairman, in presenting the proposals, said that it was proposed to hold a joint meeting at 9 a.m. on Thursday, August 26th, in the building of the Royal Geographical Society, of all members of those Commissions who were present at the Session and of any persons who had been commissioned to act for absent members of the Commissions or had similar special interest in the work of the Commissions.

*The proposals were approved.*

### 8. INTERNATIONAL PALEONTOLOGICAL UNION: COUNCIL MEETINGS

Professor B. F. Howell (U.S.A.) announced the times of meetings of the Council of the International Paleontological Union, and extended to members of the Council of the Congress an invitation to attend those meetings.

### 9. GENERAL ASSEMBLY, WEDNESDAY, AUGUST 25TH

Mr. A. J. Butler, General Secretary, made an announcement concerning the composition of the platform party at the General Assembly to be held at the Royal Albert Hall on Wednesday, August 25th.

The Meeting closed at 9-25 p.m.

## Second Meeting of the Council, 5-30 p.m. on Wednesday, August 25th

Professor H. H. Read (President) was in the Chair.

One hundred and thirty-eight Members were present.

### 1. PRESENTATION OF THE MINUTES OF THE PRELIMINARY MEETING

The Chairman explained that owing to the late hour at which the Preliminary Meeting had been held the previous evening, it had not yet been possible to prepare the minutes for distribution, and he therefore asked the Council to agree to defer the presentation of those minutes until the next meeting.

*This was agreed.*



## PART I: GENERAL PROCEEDINGS

### 2. INTERPRETATIONS AT COUNCIL MEETINGS

Mr. A. J. Butler, General Secretary, again explained the arrangements for interpretation of speeches.

### 3. MEMBERSHIP OF THE COUNCIL

The Chairman proposed that Professor V. C. Illing be made an additional member of the Council.  
*This was agreed.*

### 4. INTRODUCTION BY THE DELEGATION OF THE U.S.S.R. OF A PROPOSAL THAT THE RUSSIAN LANGUAGE BE AN OFFICIAL LANGUAGE OF THE CONGRESS

The Chairman, in calling upon Professor V. V. Belousov of the U.S.S.R. delegation to introduce his proposal, explained that the proposal had been transmitted to the Eighteenth Session from the Seventeenth Session in Moscow. As the proposal was a very important one and as it was hoped to initiate a great deal of business at the present meeting, he proposed that Professor Belousov should simply introduce the proposal at the present meeting and that a decision on it should be deferred until the meeting of the Council on Friday evening, August 27th.

Professor V. V. Belousov (U.S.S.R.), in introducing the proposal that the Russian language be an official language of the Congress, said that Russia occupied one-sixth of the surface of the globe. It was impossible to understand and appreciate the general trends of geological science without having a knowledge of the trend of geological thought in the U.S.S.R. The many thousands of geologists in the U.S.S.R. spoke Russian, and the Russian language was closely allied to the languages of many geologists of other Eastern European countries. During the last two decades geology had made remarkable progress in Russia, and it was generally recognized that in many fields Russia had taken the leading position in world geology. The names of outstanding Russian geologists were known throughout the world. He could assure the Council that the present achievements of geologists in the U.S.S.R. had surpassed anything that delegates to the Seventeenth Session of the International Geological Congress had come to know of as a result of their personal experience.

The geologists of all countries were watching with keen attention the progress of geological science in the U.S.S.R. Many people were using Russian geology in their studies.

In the science of geology, as well as in other aspects of life, the Soviet Union had long been one of the Great Powers, and accordingly the U.S.S.R. must in all respects be on the same level as other Great Powers in the International Geological Congress.

The Russian language was no longer an unfamiliar language in the world. It was an official language in the United Nations Organization and at many of the most important international conferences. In those circumstances, public opinion, not only in the Soviet Union but throughout the world, would fail to understand why the Russian language should not be spoken at the International Geological Congress. Discrimination against the Russian language had now become an historical anomaly which ought to be corrected.

The delegation of the U.S.S.R. expressed its conviction that, beginning with the present Session of the Congress, the Russian language should be accepted as one of the permanent official languages of the International Geological Congress.

The Chairman felt that the Council would agree that Professor Belousov had put forward a very strong claim for the Russian language to be considered an official language of the Congress. There would be certain technical difficulties with regard to interpretations and printing if Russian were included as an official language, but he had no doubt that those technical difficulties could be surmounted. In view of the importance of the proposal, however, he hoped that the Council would agree to defer consideration of it until the meeting on Friday evening.

*This was agreed.*



5. PRESENTATION BY PROFESSOR W. B. R. KING OF A PROPOSAL TO APPOINT A TEMPORARY COMMISSION TO REPORT ON PROBLEMS CONNECTED WITH THE PLIOCENE-PLEISTOCENE BOUNDARY (COUNCIL PAPER 4)

Professor W. B. R. King (Great Britain), in presenting his proposal, said that the question of the Pliocene-Pleistocene Boundary had given rise to very much ambiguity in the writings on various topics which dealt with the upper Pliocene and the lower Pleistocene. This was particularly the case amongst workers in pre-history and in various other branches of the sciences.

The matter was being discussed in Section H, and it had been thought advisable that a Temporary Commission should be set up by the Council in order that the deliberations of Section H might be brought back to the Council. It was hoped that some agreement might be reached on these points.

He proposed that a Commission be established with the following terms of reference:—

“To examine the various methods and schemes which have been used to define the Pliocene-Pleistocene Boundary, and to report thereon to the Council at the end of the Eighteenth Session with recommendations regarding future use of the existing nomenclature and other relevant matters.”

If the Council agreed to the proposal to appoint a Temporary Commission, he would then suggest certain names for membership of the Commission.

Dr. Eliot Blackwelder (U.S.A.) seconded the proposal.

Dr. R. C. Moore (U.S.A.) felt that, while the proposal to appoint such a Commission to undertake studies and make recommendations was a good one, the International Geological Congress should not in any circumstances undertake to define stratigraphic boundaries which involved questions of fact.

*The proposal was agreed to.*

Professor W. B. R. King (Great Britain), in suggesting certain members for the Temporary Commission, proposed that the Commission should have power to co-opt additional members as its deliberations proceeded. The names suggested were as follows:—

Dr. A. T. Hopwood

Professor W. B. R. King

Dr. L. S. B. Leakey

Professor C. I. Migliorini

Mr. Hallam L. Movius, Jr.

Dr. K. P. Oakley

Professor I. M. van der Vlerk

Professor D. M. S. Watson

Mr. E. J. Wayland

Professor F. E. Zeuner.

In proposing these names, an endeavour had been made to cover the various branches of the subject—vertebrate, stratigraphical and archæological—and as many countries as possible; but he would be glad to receive the names of additional helpers from other parts of the world.

The Chairman invited delegates to suggest additional names for membership of the Commission.

Dr. N. N. Chatterjee (India) proposed that Dr. D. N. Wadia be added to the list of members.

Dr. R. Kozłowski (Poland) suggested that Professor W. Szafer be a member.

A delegate proposed the name of Dr. Suzette Gillet of Strasbourg University.

Professor Pierre Pruvost (France) proposed that Professor Dubois be invited to become a member of the Commission.

Professor S. E. Hollingworth (Great Britain) thought that the Danish delegation should be asked to propose a name.

Dr. H. Ödum (Denmark), while expressing thanks for the proposal, regretted that the Danish delegation had not immediately available a suitable specialist.

Professor B. Sahni (India) proposed Professor F. Florschütz as a member of the Commission.

The Chairman asked that the names which had been proposed be sent in writing to the General Secretary.

*The proposed composition of the Temporary Commission was agreed to.*

## PART I: GENERAL PROCEEDINGS

### 6. PRESENTATION BY DR. LOUIS L. RAY OF A PROPOSAL TO APPOINT A COMMISSION FOR THE PREPARATION OF A WORLD PHYSIOGRAPHIC PROVINCE MAP (COUNCIL PAPER 5)

Dr. Louis L. Ray (U.S.A.) thought it was unnecessary to add very much to what was said in Council Paper 5. He simply wanted to emphasize the desirability which many geologists felt of preparing a World Physiographic Province Map as an essential complement to the Geological Map of the World. The Geological Map showed something of the structure of the bedrock; the Physiographic Province Map would give some conception of the relationship of the landforms. Probably most geologists were familiar with the Physiographic Map which had existed in the United States for some time. This map had standardized to a large degree geological and physiographic thinking in the United States in relation to large provinces.

He suggested that anyone who was interested in the preparation of such a map should meet at 4 p.m. on Friday, August 27th, in the Geological Museum.

The Chairman felt sure that the Council would note and support Dr. Ray's suggestion that those who were interested in the proposal should meet at that time.

### 7. PRESENTATION BY PROFESSOR W. WAHL OF A PROPOSAL FOR INTERNATIONAL CO-OPERATION IN THE ACCURATE CHEMICAL ANALYSIS OF METEORITES (COUNCIL PAPER 6)

Professor W. Wahl (Finland) said that of the 755 stony meteorites that had fallen, about 120 were unclassified and only about 110 had been analysed. There had, therefore, been comparatively little progress in obtaining knowledge of stony meteorites. All the calculations which had so far been made in order to obtain an average of the composition of meteoric matter had been made on the basis of analyses some of which were good and others inferior. Since these analyses would influence views on the composition of meteoric matter very considerably, it was desirable that further attention should be given to them.

The proposal was that there should be international co-operation with a view to co-ordinating and instituting research. The Executive Committee suggested that a small temporary committee should be appointed to consider the matter and report to the Council at its meeting on August 30th. It had been suggested that the directors of the large museums possessing collections of meteorites should be members of that committee. There were present at the Congress Dr. Campbell Smith, Professor Belousov, Professor Roger of the Museum national d'Histoire naturelle de Paris, and representatives of the Smithsonian Institute at Washington and the American Museum of Natural History. There were also present specialists on meteorites whom it was proposed should join the committee, namely Dr. L. J. Spencer and Professor Paneth.

Dr. J. P. Marble (U.S.A.) heartily commended Professor Wahl's proposal for international co-operation in this important field, which dealt with so many important geological problems. There were in existence at the present time various national museums and organizations which were concerned with the exchange of material and the analysis of meteorites.

He referred particularly to the Soviet Union's Committee on Meteorite Studies, which had been engaged in very cordial co-operation with other institutions; the Committee of the National Research Council of the United States on Studies of Meteorites, and similar organizations in Great Britain and other countries. There had not as yet, however, been any formalization of effective arrangements for international co-operation in this important field.

Dr. D. S. Korzhinski (U.S.S.R.) said that great attention was being given to the study of the chemical and mineralogical composition of meteorites and the study of the places at which they fell in the Soviet Union. All this work was co-ordinated by the Committee on Meteorites which was attached to the Academy of Sciences of the U.S.S.R. He felt that Professor Wahl's proposal was one which it was essential for the Council to support.

Sir Edward B. Bailey (Great Britain) wondered whether Professor Wahl's proposal would be in any way influenced by any decision which might be taken to set up an International Union of Geology.

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The Chairman thought that the Council ought to continue its consideration of the proposal irrespective of whether or not an International Union of Geology were set up.

Dr. N. N. Chatterjee (India) supported Professor Wahl's proposal. He considered that full co-operation between the different centres and different countries would lead to a better understanding of the physical properties of meteorites, and such information ought to be collected and published under the auspices of the International Geological Congress.

*The proposal was agreed to.*

Professor W. Wahl (Finland) suggested that the Committee meet at 5-30 p.m. on Thursday, August 26th, in the Geological Museum.

### 8. PRESENTATION BY DR. H. SCHÜRMANN ON BEHALF OF THE NETHERLANDS GEOLOGICAL AND MINING SOCIETY OF A RECOMMENDATION CONCERNING THE DEFINITION OF THE PLEISTOCENE-HOLOCENE BOUNDARY (COUNCIL PAPER 7)

The Chairman, in the absence of Dr. Schürmann, drew the Council's attention to the Executive Committee's recommendation concerning this proposal—namely, that the Council should recommend the definition proposed as being worth the consideration of botanists, archæologists and geologists, but should not at present indicate that it accepted the definition as final. That was as far as the Executive Committee went.

Professor W. B. R. King (Great Britain) felt that it would not be desirable to add this matter to the labours of the Temporary Commission which was to try to define the bottom of the Pleistocene. He had discussed the matter with Dr. Godwin, the leading British expert on this problem, who was emphatic that the time was not yet ripe to come to a final definition of the upper boundary of the Pleistocene. In three or four years' time it should be possible to speak with authority.

Dr. L. S. B. Leakey (Kenya) felt strongly that the proposal as it stood was not one which the International Geological Congress should possibly support, since it gave a definition of the Pleistocene-Holocene Boundary which would be applicable only in certain limited parts of Europe. If and when a definition was arrived at, it must be one which would have a wider application and concern Africa and America.

Dr. N. N. Chatterjee (India) suggested that the question of the definition be left to the Temporary Commission which was to deal with the Pliocene-Pleistocene Boundary.

Dr. R. C. Moore (U.S.A.) said that a very important question of policy was raised in the proposal, namely, that no Council of an International Geological Congress should undertake to legislate on matters of definition of stratigraphic boundaries. A proposal of this nature was unsuitable for consideration by the Council.

Dr. H. Ödum (Denmark), speaking not only on his own behalf but on behalf of the Scandinavian countries, said that Scandinavian geologists would welcome any steps that were taken to facilitate the study of these questions, but the problem presented in the proposal was purely formal, and since it was not possible to hear what the Scandinavian scientists had to say on the subject, he considered that it would be inappropriate to accept the proposal.

M. J. J. Bourcart (France) said that the problem was not an exclusively North European or North American problem. One must take into consideration those who were studying the Mediterranean aspect of the subject. Any proposal should be based on the results not only of the work of scientists in the Northern countries, but on the work of those who were studying the Mediterranean region; and there should be a correlation of such work.

The Chairman observed that the general opinion of the Council seemed to be in agreement with the Executive Committee's recommendation, namely, that the Council should take note of the proposal and, if necessary, reconsider it in three or four years' time. As regards the suggestion that this matter should be considered by the Temporary Commission which had been set up, as Professor King had said, that Commission already had enough to do. Unless there was objection, he would take it that the Council agreed with the Executive Committee's recommendation.

*This was agreed.*



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### 9. PRESENTATION BY DR. H. SCHÜRMANN ON BEHALF OF THE NETHERLANDS GEOLOGICAL AND MINING SOCIETY OF A RECOMMENDATION THAT THE CONGRESS SHALL ATTEMPT TO PROMOTE THE REVIVAL OF CERTAIN JOURNALS OF ABSTRACTS (COUNCIL PAPER 8)

The Chairman said that while the Executive Committee, like everybody else, would welcome the revival of such Journals, it felt that the matter was one that should be referred to the Bureau of the Congress for investigation, and that a proposition should be made at some later date. He hoped the Council would agree to that recommendation.

Professor M. Legraye (Belgium), as General Secretary of the Geological Society of Belgium, which had published the *Revue de Géologie*, suggested that the Bureau should consider whether, in view of the excellent bibliographies published by the Geological Society of America and the Society of Economic Geologists, it would be either useful or financially justifiable to publish similar bibliographies in German or in French.

The Chairman said that this point would be considered by the Bureau.

Professor D. Andrusov (Czechoslovakia) said that while he was quite ready to accept part of the Netherlands proposal, he did not think that the revival of a German publication was practicable in the present world situation. Apart from the publication of the Belgian Society, which had been mentioned, there was an excellent periodical published in Paris, and it might be possible to enlarge that publication and widen its field of distribution.

The Chairman said that if the matter were referred to the Bureau for consideration, all these matters could be taken into account by the Bureau.

Professor V. V. Belousov (U.S.S.R.) thought that the Bureau should be asked to study the question in general without indicating any particular journals.

Professor P. Fourmarier (Belgium) said that there was already a Commission to deal with abstracts. He felt that this Commission would be in a position to study the subject of the Netherlands proposal and to make use of the existing knowledge in its possession.

Mr. A. J. Butler, General Secretary, informed the Council that he had recently received a letter from the President of the Commission on Authors' Abstracts, Mr. Goldman, who wished especially to emphasize, from his own viewpoint as President and as originator of the Commission, that the Commission should exist for the limited and sole purpose of arranging that authors in every country should, as far as possible, give an abstract of their papers at the head of the papers.

The Chairman felt that he could interpret the Council's feeling to be that the Bureau be instructed to study the general question of geological abstracting, taking into account the remarks made in the Council.

*This was agreed.*

### 10. PRESENTATION BY DR. G. F. HERBERT SMITH, ON BEHALF OF THE SOCIETY FOR THE PROMOTION OF NATURE RESERVES, OF A RECOMMENDATION CONCERNING NATIONAL GEOLOGICAL RESERVES (COUNCIL PAPER 9)

Dr. G. F. Herbert Smith (Great Britain) said that the recommendation for the establishment of National Geological Reserves in countries where as yet none existed, and as a preliminary step the preparation of a list of suitable sites, was submitted by him on behalf of a special Committee of which he had had the honour to be Chairman, and of which Dr. Oakley had been Secretary, which had sat even at the height of the flying bomb attacks on London, to consider the problem in relation to England and Wales. The result of the Committee's deliberations was contained in the Report on *National Geological Reserves in England and Wales*, which had appeared in September, 1945.

What was required in each country was a list of features of exceptional scientific importance which the planners could study at an early stage. He hoped that the recommendation would receive favourable consideration by the Council.

Dr. N. N. Chatterjee (India) thought that the Council ought as a matter of principle to adopt a resolution requesting all countries to take an interest in the conservation of mineral resources.



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The Chairman observed that the recommendation before the Council did not deal with mineral resources or reserves, but with the preservation of the localities of geological importance.

Dr. L. S. B. Leakey (Kenya) expressed the opinion that the recommendation before the Council was not strong enough. He felt that a resolution should be prepared by the Executive Committee and that that resolution should go before the General Assembly. The resolution, if passed, would then have the support of a full and powerful body, and it would not simply be a matter of a few delegates urging their Governments to see that adequate steps were taken to protect geological sites. At the Pan-African Congress last year that course had been followed, and a remarkable degree of success had been obtained.

Mr. A. J. Butler, General Secretary, suggested that Dr. Smith and Dr. Leakey were in fact entirely in agreement. Dr. Leakey would like to see the spirit of Dr. Smith's recommendation, with which he fully agreed, formulated into a resolution which would have the backing of the whole Congress. If the Council accepted the recommendation, the Bureau could be instructed to communicate a resolution to the Governments, through the national delegations, immediately the Eighteenth Session closed. In order to give the resolution the backing of the whole Congress, mention could be made of it in the Report of the Council to the General Assembly.

The Chairman asked Dr. Smith and Dr. Leakey whether the General Secretary's suggestion met their wishes.

Dr. L. S. B. Leakey (Kenya) said that he was in agreement with that course, provided that delegates were not simply left to make recommendations. The full backing of the Congress was required in this matter.

Dr. G. F. Herbert Smith (Great Britain) said he would be prepared to leave it to the Bureau to draw up a suitable resolution.

*This was agreed.*

*The Council adjourned.*

## Third Meeting of the Council, 5-30 p.m. on Friday, August 27th

Professor H. H. Read (President) was in the Chair.

One hundred and ninety-three Members were present.

### 1. PRESENTATION OF THE MINUTES OF THE PRELIMINARY AND SECOND MEETINGS

The Chairman asked the Council to take note of the Minutes of the Preliminary and Second Meetings, which had just been circulated. As Members would not as yet have had time to read the Minutes, he requested them to submit to the General Secretary, before the next meeting of the Council, any corrections they wished to make.

### 2. ANNOUNCEMENT BY MADAME M. E. BASSE DE MENORVAL

Madame M. E. Basse de Ménorval (France) made an announcement concerning a regional congress on the subject of "Sédimentation et Quaternaire" to be held from May 24th to June 2nd, 1949, in the regions of Charentes and Dordogne.

### 3. DISCUSSION OF AND VOTE UPON THE PROPOSAL THAT THE RUSSIAN LANGUAGE BE AN OFFICIAL LANGUAGE OF THE CONGRESS

The Chairman recalled that Professor Belousov had introduced this proposal at the Second Meeting of the Council.

Sir Edward B. Bailey (Great Britain) said that he counted it a privilege to second the important proposal made by his friend Professor Belousov. He appreciated this opportunity because he had been instrumental in securing deferment of the consideration of a similar proposal made at the Seventeenth Session of the Congress in Moscow. On that occasion he had taken the view that it was unwise to

## PART I: GENERAL PROCEEDINGS

consider the addition of a language as an official language at a meeting held in the country where that language was spoken, and the Council had agreed to that view.

The Council was now in an ideal position to consider the proposal. Members were no longer the guests of generous hosts in the country which spoke that language. In the present Council the Soviet Delegation were few in number. It was for the non-Russians to decide the matter on the basis of what was right and what was wrong.

The Russian language was spoken over a great portion of the land surface of the globe, and in that immense area geological research was proceeding with an activity that was not surpassed in any other region of the world. The English language also was spoken over a large area and in that area also there was great concern for geological research.

He recognized the inconvenience that would result from the inclusion of another official language, inconvenience which would be particularly marked in the case of Russian because of its alphabet; but he asked the Council to adopt the proposal by a large majority in order that the matter might be settled according to the principles of justice and fair play, and to set aside all minor issues of inconvenience.

Dr. Eliot Blackwelder (U.S.A.) informed the Council that the United States Government delegation had instructed him to say that they recommended the adoption of Russian as one of the official languages of the International Geological Congress.

Dr. Roman Kozlowski (Poland) said that the Polish delegation supported the Soviet proposal. The small technical difficulties that might arise if the proposal were adopted would be more than compensated by the increase in harmonious working among geologists throughout the world.

Dr. W. F. P. McIntock (Great Britain) while completely agreeing with everything that Sir Edward Bailey had said, asked for clarification on one point of detail. At the conclusion of his statement, Professor Belousov had said: "The delegation of the U.S.S.R. expresses its conviction that, beginning with the present Session of the Congress, the Russian language should be accepted as one of the permanent official languages of the International Geological Congress." Did this mean that publication in Russian would be an additional responsibility of the existing Executive Committee and General Organizing Committee for the Eighteenth Session.

The Chairman asked Professor Belousov whether it was part of his proposal that Russian should be one of the languages in which the "Compte rendu" of the present Session would be published.

Professor V. V. Belousov (U.S.S.R.) said that Dr. McIntock's question was just and understandable. The Soviet Delegation would like to see the Russian language recognized as official at the present Session. If however any technical difficulties arose over the preparation of the documents of the Session, the Soviet Delegation was prepared to give the necessary help in overcoming them, and they had already informed the General Secretary that they were willing to do this.

Mr. A. J. Butler, General Secretary, thought that the immediate problem could be solved on the lines indicated by Professor Belousov.

Dr. L. Lutaud (France) said that the French delegation considered that the technical difficulties of the introduction of Russian would be outweighed by the advantages. He was therefore glad to announce that the majority of the French delegation would vote in favour of the proposal.

Mr. A. J. Butler, General Secretary, felt it opportune at this stage to refer to certain constitutional and technical points. The Russian language had, in fact, been an official language of the Congress, though only on a temporary basis, for eleven years, since the agreement of the first meetings of the Council and the Assembly of the Seventeenth Session in 1937 until two days ago, when Professor Belousov had handed over to the present President—in use throughout a complete and lengthy cycle of the constitutional process of the Congress. During that cycle, the Seventeenth Session had been successfully organized, and the Report of that Session had been made available. In the last two years the organizers of the present Session had been in correspondence with the representatives of the last Bureau in Moscow, and there had been no insuperable difficulty of language.



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From precedent and usage for eleven years, there was reason for the adoption of Russian as an official language. He felt that if the Soviet geologists would continue to aid the organizers of future sessions to overcome the practical difficulties of interpretation, translation and printing, the acceptance of the proposal that Russian be an official language would be of considerable assistance to future Sessions of the Congress.

Dr. L. V. Čepek (Czechoslovakia) said that of the five official languages, three were Roman, and the Slavonic languages were not represented at all. This proportion did not correspond either to the number of geologists in the Slav countries or to the volume of their research work. The Czechoslovak delegation would vote in favour of the proposal.

Professor P. F. J. Fourmarier (Belgium) said that, for the reasons which had been stated by other speakers and particularly by Sir Edward Bailey, and in view of the publications which had been issued concerning the Seventeenth Congress, as well as publications which showed the very great importance of the work that was being done by the geologists of the U.S.S.R., the Belgian delegation would vote in favour of the proposal.

Professor L. W. Collet (Switzerland) said that he was in favour of the proposal for the same reasons as had been given by Sir Edward Bailey.

Dr. R. Fabiani (Italy) also supported the proposal.

*The proposal was adopted by a large majority.*

Miss T. Stadnichenko (U.S.A.) said that, as one who had been born and educated in Russia, she welcomed and rejoiced in the decision of the Council to use Russian as an official language of the Congress. She wished, however, to add a further request to that which the General Secretary had made. During the last three years she had suffered disappointment in her search for Russian literature.

In his introduction of the proposal, Professor Belousov had stated that the present achievements of geologists in the U.S.S.R. surpassed anything that delegates to the Seventeenth Session had come to know of as a result of their personal experience. But the Library of the Geological Survey in the United States had been unable to get geological literature from Russia, in spite of numerous requests. It had been hoped that many books and maps would be available after the war; but the fact was that since the end of the war, less and less had been received.

She concluded by making a sincere and strong plea to the delegates of the U.S.S.R. to help geologists in other countries to learn what was being done in Russia and to facilitate communications between United States and Soviet geologists.

The Chairman observed that all geologists were anxious to obtain Russian literature.

Professor V. V. Belousov (U.S.S.R.), on behalf of the Soviet delegation as well as on behalf of all Soviet geologists, expressed gratitude to the Council for its recognition of the Russian language as an official language of the International Geological Congress. This action would be much appreciated by Soviet geologists. He felt sure that the Council's decision would strengthen co-operation between the geologists of the Soviet Union and those of other countries, and would be a great contribution to the progress of geological science.

### 4. DISCUSSION OF THE PLACE OF MEETING OF THE NINETEENTH SESSION OF THE CONGRESS

Professor L. Lutaud (France) said it was a great pleasure to him to transmit on behalf of the French Government an invitation with regard to the place of meeting of the Nineteenth Session of the Congress. The invitation was one which had already been made by Professor Jacob, as Head of the French delegation, at the Seventeenth Session of the Congress in Moscow. On that occasion Professor Jacob had invited the Congress to hold its Eighteenth Session in Algiers, a territory which might be new to many, but which had been deeply and seriously studied. Algiers and the North African region were, as Professor Jacob had said, ready to be shown and discussed.

However, at the Seventeenth Session the British delegation had extended an invitation to the Congress to hold its Eighteenth Session in London and had pointed out that no Session of the Congress had been held in London for a long time. Accordingly, the French delegation had given way, and he could

## PART I: GENERAL PROCEEDINGS

now say that they were very pleased they had done so, considering the excellent way in which the Eighteenth Session had been organized and the multitude of excursions which had been arranged.

He was happy to be able again to give the invitation which France had given in 1937 and to request the Congress to hold its Nineteenth Session in Algiers, when it could study Algeria, Tunisia, Morocco and parts of the North Sahara region. He had an official letter of invitation from the French Government which he would hand to the Chairman for transmission to the Bureau.

He wished to add one request: if the Congress was kind enough to accept this invitation, he asked that, owing to conditions in Algeria, which was not quite so prepared for international congresses as were European countries, the session should be held in 1952 and not in 1951.

(Professor Lutaud then handed the letter of invitation to the Chairman.)

The Chairman expressed the sincere thanks of the Council to Professor Lutaud and the French Government for their invitation.

Dr. D. N. Wadia (India) said that it was his pleasant privilege to deliver to the Council the formal invitation of the Government of India for the Congress to hold its Nineteenth Session in India. He had been instructed by telegram to deliver this invitation, and a formal written invitation from New Delhi would follow. The Government of India proposed as provisional dates for the Session some time between November, 1951, and February, 1952. The one hundredth anniversary of the foundation of the Geological Survey of India fell within those dates, and the occasion would be a suitable one for the International Geological Congress to visit India, which was one of the earliest centres of geological research.

He sincerely hoped that the Council would accept this invitation.

The Chairman asked Dr. Wadia to transmit to his Government the warm thanks of the Council.

There were now two invitations before the Council, and rarely in its history had the Congress been faced with so difficult a decision. Both countries which had given invitations were remarkable in the recent development of their geological studies and both of them were countries which all members of the Congress would very much like to visit.

He suggested that a decision should be deferred until the meeting on Monday, August 30th, so that members would have time to consider these two attractive invitations.

*This was agreed.*

### 5. DISCUSSION ON THE QUESTION OF FORMING AN INTERNATIONAL UNION OF GEOLOGY (COUNCIL PAPER 10)

The Chairman said that a full statement of the topic of discussion was set out in Council Paper 10. He proposed that the Council should commence its discussion of the proposal and then adjourn until the following day at 9 a.m. The Chairman then invited Dr. Joseph Needham, lately Director of the Natural Science Section of UNESCO, to address the Council.

Dr. Joseph Needham (UNESCO) expressed his regret at the absence of Professor Stratton, Secretary-General of the International Council of Scientific Unions, which embodied practically all the great branches of science in a series of organizations for maintaining day-to-day contact. He had had an opportunity of glancing at Council Paper 10, and he thought he would have the agreement of Professor Stratton in saying that it very clearly and precisely described the problem before the Council.

Before coming to the main body of his remarks, he wished to convey to the Congress the warmest greetings from Dr. Julian Huxley, the Director-General of the United Nations Educational, Scientific and Cultural Organization, and from Dr. Pierre Roget, the French physicist, who was his (Dr. Needham's) successor as Director of the Natural Science Section of UNESCO.

The essence of a Union was the maintenance of constant day-to-day contact in a manner which could not be done by Congresses which met triennially. Geology was now practically the only great branch of science which had not an International Union. From the point of view of UNESCO there were two main reasons why a union in a branch of science was exceedingly valuable. First, it provided a channel for funds which might become available internationally to that branch of science. During the past two years UNESCO had in each year allocated a sum of approximately 250,000 dollars in



grants in aid of the various Unions federated in the Council of Scientific Unions, to help publication and other scientific projects, and to assist men of science to attend international congresses.

It was, however, the second reason which was really much more important. Unless there was an authoritative international body representing a certain branch of science, it was extremely difficult for the United Nations' Secretariat to get the best advice and to know where to go for it. It was really a great gap that so far there was no International Union of Geology. He believed that an International Palaeontological Union had achieved some success, and he presumed that it would be part, as a commission or section, of the International Union of Geology.

The agreement with UNESCO to which reference was made in Council Paper 10 left complete autonomy to the International Council and its federated Unions.

In conclusion, he would mention that although the U.S.S.R. was, as yet, not a member of UNESCO, it was a very important member of the United Nations and also of four of the existing international scientific unions. Czechoslovakia and Poland were on the Executive Board of UNESCO, and Hungary and Austria were among the members of UNESCO.

He felt that there was every reason why there should be an International Union of Geology federated with the International Council of Scientific Unions.

The Chairman thanked Dr. Needham. The Council would now be equipped to consider the matter at its next meeting.

*The Council adjourned.*

The Third Meeting of the Council was resumed on Saturday, August 28th, at 9 a.m. Professor H. H. Read (President) was in the Chair.

Sixty-three Members were present.

#### 5. DISCUSSION ON THE QUESTION OF FORMING AN INTERNATIONAL UNION OF GEOLOGY (COUNCIL PAPER 10)

The discussion was continued.

Professor P. Pruvost (France), President of the Paleontological Union, informed the Council that the Council of the International Paleontological Union, desiring to co-operate with UNESCO and with the proposed International Union of Geology, if formed, had authorized him to appoint Dr. C. J. Stubblefield as its official observer and representative in any negotiations or action that might be necessary for that purpose between now and the next Session of the International Geological Congress. The Council of the International Paleontological Union had instructed Dr. Stubblefield to keep the President and the Secretary of the Union informed of developments, to advise them of any action which, in his opinion, ought to be taken by them or by the Council during that period, and to report to the Council when it was convened at the time of the next Session of the International Geological Congress, so that the Council might then take such further steps towards this co-operation as might seem desirable.

Dr. W. F. P. McLintock (Great Britain) said that in his view the Council of the Congress in Brussels in 1922 had come to a correct decision, and he was convinced that, in the light of existing circumstances, that decision still remained the correct one.

In the International Geological Congress they had one of the most firmly established international organizations in the whole field of the sciences. The Congress was one of the oldest of all international congresses. It had always been recognized that the Congress was essentially a function of the Government of the inviting country, and his experience was that that arrangement had worked well and satisfactorily. From one Congress to the other continuity had been ensured by the existence of the Bureau, which was also perfectly capable of acting as an international organization through which other international organizations could easily get in touch with geologists throughout the world.

The international organization which was asking the Council to agree to the formation of an International Union of Geology was, of course, UNESCO, and inducements, largely financial, were held out to the Council to consent to the formation of that Union.

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The Congress had been run in Great Britain without seeking external advice or help. A large number of delegates had assembled. There had been co-operation from their Russian friends, who had run the previous Congress, and from geologists throughout the world. He thought it would be generally agreed that the result was a successful Session. He could not see what useful purpose, from the point of view of the Congress, an International Union of Geology would be likely to serve.

Speaking as a Government official, he could see objections to such a Union. The organization of a Geological Congress was a great responsibility, since one of its essential features was that the inviting country must do its best to disclose and explain its geology to the visiting international geologists; and the responsibility could in his opinion be met only by a Government organization. It was sometimes a difficult matter to persuade the Government of a country to undertake the responsibility. If a Union were formed, he thought, there was a danger of a Government telling its geologists, when it was in fact the duty and the occasion for that Government to issue invitations, "You have an International Union—let the International Union run the International Congress." It might be thought that that danger was a remote one, but his experience was that it was not as remote as might be imagined.

For those reasons, speaking personally and not on behalf of the United Kingdom delegation, he could see no use in establishing an International Union. An adequate organization already existed in the body of the Congress.

Dr. George B. Cressey (U.S.A.) said that he had been asked by Professor Stratton, the Secretary of the International Council of Scientific Unions, to express his regret at not being present at the meeting.

Although Dr. Cressey spoke as a geologist, he had also had some contact with some of the other Unions which made up the International Council of Scientific Unions. He could assure the Council that each Union operated entirely autonomously, without direction from the International Council of Scientific Unions, and that the International Council, in its turn, was under no control from UNESCO.

The advantage of having Unions was that in the Unions the Secretary usually continued for two or three sessions, thus giving a certain continuity.

Dr. Cressey explained various methods by which existing Unions paid their dues. He suggested that if an International Union of Geology were formed, the quota of financial assistance to the Union by each country should be placed on a voluntary basis, following the example of the International Postal Union, rather than be automatically fixed by reference to population. He understood that in the Unions each country was given one vote on all professional matters, but that on matters of financial policy the vote was related to the financial contribution which that country undertook.

Dr. A. Desio (Italy) said that in April, 1947, he had suggested the creation of an International Union of Geology, to have two aims—a cultural aim, and a social aim.

He agreed with the delegate of the United Kingdom that the cultural aim could be carried out by the Bureau of the Congress, but he did not feel that the Bureau could carry out the social aim, which was mainly to help geologists who found themselves unable to carry on their work because of lack of financial resources.

There was a big difference between the cultural aim and the social aim, and he felt that while the Bureau could deal with the cultural side, it could not deal with the social side. On coming to London a few days ago, the Italian delegation had brought forward a proposal for the constitution of such an International Union, without knowing what the Council proposed with regard to a constitution.

He wished once more to stress the difference between the cultural and the social sides, and to say that he was in favour of the formation of an International Union of Geology.

Professor E. Pogrebitsky (U.S.S.R.) said that the Soviet delegation did not consider it necessary to set up a new International Union of Geology apart from the International Geological Congress. They were of the opinion that such a Union would only hamper the activities of the Congress. If two such organizations existed side by side, one of them must eventually usurp the functions of the other. It was doubtful whether the infant, the International Union of Geology, would be more successful than its father, the International Geological Congress. On the other hand, the fruitfulness and vitality



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of the International Geological Congress had been proved by its activities during the seventy years of its existence. What was necessary was that efforts should be made to ensure that the work of its permanent Commissions would be more and more fruitful.

In the opinion of the Soviet delegation there was no reason to revise the decision of the Council of the Congress held in Brussels in 1922, which rejected the proposal to create an International Union of Geology.

Dr. G. F. Herbert Smith (Great Britain) said that he spoke from a different angle from that of other delegates, since he happened to be the organizer of the United Kingdom delegation which was to go to Fontainebleau at the end of September at the invitation of the French Government and UNESCO for the purpose of establishing an International Union for the Protection of Nature.

From his experience, he was quite sure that the Congress need not fear that this proposed Union, if set up, would in any way interfere with the activities of the Congress. He was convinced that Dr. McIntock's pessimistic views were groundless. He felt that if the present Congress had been held under the direct auspices of UNESCO, it might have been possible to secure greater assistance in organizing it. He favoured the formation of a Union.

Sir Lewis Fermor (Great Britain) said that since 1910 he had attended five International Geological Congresses. Without exception, those five Congresses had been well organized, and he had no complaints to make about their organization. He could not see any need to have an additional organization, which would simply complicate affairs. He therefore proposed to vote against the idea of having an International Union of Geology.

Sir Edward B. Bailey (Great Britain) said that he shared the gratitude which had been expressed by previous speakers of the work done during the last seventy years by the International Geological Congress, and equally he shared their determination that the fundamental organization of the Congress must not be altered. He also agreed that the fundamental organization of the Congress must, broadly speaking, be successively national rather than continuously international—and for that very reason he intended to vote in favour of the creation of an International Union of Geology.

He had read the objects of the Union, as stated in the Council Paper, and it seemed to him that they had been very carefully thought out and would meet the case. Was it not desirable that there should be some organization that would be continuously in session? At the present Session the question of meteorites had been raised. The care of and research into meteorites would be much better looked after by a body that was continuously international than by a body that was discontinuously national. There were similar cases in which the same argument applied.

He took the view that on no account must they risk or endanger the present organization of the Congress. There ought, however, to be a new Union to take over the job of continuity. It was some fifty years since a Congress had previously been held in Great Britain, and in the intervening period there had been no British body concerned with continuity.

Professor V. V. Belousov (U.S.S.R.) said that he had not intended to speak, since Professor Pogrebitsky had expressed the views of the Soviet delegation. The reason he had intervened was that one speaker had suggested that if the present Session had been organized by an International Union of Geology, the organization would have received more assistance. He wished to point out that the Soviet delegation regarded the organization of the Session as having been ideal, and felt that the hosts had contributed enormously to the success of the Congress.

It must be borne in mind that the International Geological Union, should it be set up, is to be tied up with some other organizations. It was not for the Congress to decide the fate of such organizations; that was a matter which concerned the organizations themselves. The Soviet delegation preferred to have a quite free organization of scientists. He would like, in conclusion, to cite a Russian proverb—it was better to have a bird in the hand than two birds in the bush.

Professor P. Pruvost (France), speaking not only personally but as President of the Geological Society of France, said that the question could be considered from the point of view of whether the Congress should be absorbed by, and become part of, UNESCO. If the matter were put in that way,



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every member of the Council would vote against the proposal. The geologists were the first group to become international nearly a century ago. Geologists had shown the way to many other scientists who had followed in their footsteps and formed international unions. It might even be said that it was a pity that the United Nations had not consulted the International Geological Congress with a view to adapting their methods and organization to that of the Congress, rather than ask the Congress to adapt itself to the ideas of the United Nations. If the matter were put in that way and considered on grounds of priority, so to speak, the Council would vote against the proposal to establish an International Union of Geology.

But the matter was put to the Council in another way. It was a question of whether the Council would help in the formation of a similar organization, but one whose aims were not like the aims of the Congress.

In relation to this problem, there was what he would bluntly call the financial aspect, although the Italian delegate had called it, much more politely, the social aspect. The financial side of the various international congresses was covered by the different Governments paying in contributions. The question was whether geologists were to be the only people who paid in but did not draw anything out.

For these reasons, some members of the French delegation would vote in favour of the creation of an International Union.

Dr. Eliot Blackwelder (U.S.A.) said that the United States Government delegation had not found it possible to have an adequate discussion of the matter in the short time available. In the informal talks which they had had on the subject, the general attitude had been one of doubt and scepticism, and perhaps a disposition to wait and see what reasons were put forward in favour of an International Union of Geology.

At the present moment, he spoke only for himself and not for the delegation of the United States. He would be opposed to any development that might weaken the International Geological Congress or supersede it. On the other hand, he had been considerably impressed by the reassurances that had been given by other speakers, and he was now rather disposed to be in favour of the proposal. If there were present other members of the United States delegation, he would be glad to hear their opinions.

Dr. H. Ödum (Denmark) said that the real question seemed to be how international organization was to be brought about in the field of geology, since one could not avoid having an international organization of some sort or other.

The need for an international organization existed for two reasons. The first was the necessity for correlation and co-ordination. At the present time geologists were almost flooded with invitations to international gatherings. There must be some co-ordination to eliminate overlapping and repetition. The second reason was that geologists needed the help of their Governments in order to be able to go to international meetings. If they were to go to their Governments and ask for help, it was important to be able to say that the invitations came with the authority of some organization such as UNESCO.

Dr. R. C. Moore (U.S.A.), on behalf of the United States societies which he represented, expressed his agreement with Dr. Blackwelder's remarks about the lack of any conflict between the functions of the Congress and those which the International Union of Geology would have. The advantages of continuity in the functioning between Congresses in an international way, as contrasted with the national activities of most nations in organizing Congresses, seemed to be complementary and not to be in conflict. He hoped the Council would support the proposal.

The Chairman thought it would be appropriate if at this stage Mr. Butler would comment on the functions of the Bureau in relation to the proposal.

Mr. A. J. Butler, General Secretary, said that before the meeting he had had no personal opinion on the question before the Council. In a short conversation with Dr. Needham he had been impressed by Dr. Needham's surprise at the continuity which existed already in the Congress in the form of the Bureau. He had gathered, from this conversation, that in other Congresses there was no continuity such as existed in the International Geological Congress.

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The Bureau was chiefly composed, by precedent and practice, of the heads of Government delegations to the Congress; there were always a President, a Secretary and a place to which correspondence could be addressed. The Bureau was, therefore a continuous internationally representative body. Should the idea of setting up a Union not be accepted, the Bureau might well offer to advise UNESCO.

An aspect of the matter which had impressed him during the meeting was that delegates appeared in general to be in some doubt. There did not seem to be any strong current of enthusiasm for or against a Union, and he wondered therefore whether the time was ripe for a positive decision. It was easy for a body to be constituted and then to fail because of lack of real enthusiasm. Possibly it might be better, not to embark immediately on the formation of an International Union, but to defer the matter until the next Session, to instruct the Bureau meanwhile to offer its service and co-operation to UNESCO, and to see how the situation developed.

Dr. B. F. Howell (U.S.A.) thought that many delegates felt that they would like to do something for UNESCO. On the other hand, they did not wish to do anything that would prejudice the future of the Congress. He wondered whether it would be possible to follow Mr. Butler's suggestion and proceed cautiously, perhaps by appointing an official liaison officer between the Congress and UNESCO. This would give opportunity to help UNESCO and to find out by experience what it would be best to do when the matter came before the next Session of the Congress.

Dr. R. C. Moore (U.S.A.), following the suggestion made by Mr. Butler, asked whether it would not enable the Congress to join in the International Council of Scientific Unions if the Bureau as now constituted, retaining all the present organization of the Congress, were to change its name to "Union." By making this change of name, it seemed to him that the Congress could retain all that it possessed and be eligible for anything that it wished to undertake. Would the change of name accomplish the purpose in view?

Mr. J. L. Rich (U.S.A.) opposed the idea of appointing a representative to act for the International Geological Congress. He thought it would be much better if the Bureau were to act for the Congress. He was opposed also to calling the Bureau a "Union" and having the Bureau, so called, carry out the tasks envisaged for the International Union. His opposition was based on paragraph 6 of the Council Paper, where there was a reference to UNESCO granting funds to the International Council. His experience was that the source of the funds generally controlled policy in the long run.

Dr. W. F. P. McLintock (Great Britain) suggested that, in view of the fact that many delegates had to attend other meetings and were already leaving the Council, a decision on the matter be deferred until the Council's meeting on Monday next.

The Chairman replied that if the Council wished to defer the actual vote on the proposal until the next meeting, that would be possible, but as there was a heavy programme of business for the next meeting, it would not be possible to have any further discussion of the proposal on that occasion.

Professor L. Lutaud (France) felt that after the discussion which had taken place, many delegations would like to have an exchange of views among themselves, and therefore he supported the suggestion that the vote be deferred until the next meeting.

*It was agreed to postpone a decision on the proposal till Monday, August 30th.*

The Chairman invited Dr. Needham to comment on the discussion.

Dr. Joseph Needham (UNESCO) said that there was little that he need say. He agreed with Mr. Butler that there was more continuity in the present organization of the Congress than he had previously realized. He was particularly impressed by the continuity indicated by the Paper on the Commissions.

As far as UNESCO was concerned, Dr. Moore's suggestion that all that need be done was for the Bureau to change its name was a very sensible one; the only difficulty was whether the International Council of Scientific Unions would accept it. The International Council might require some more close approximation to the general system and scheme of the other Unions. From the point of view of UNESCO, the suggestion would afford a means of contact and would be very suitable.



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With regard to Dr. McLintock's contention that Governments might tend to shift the responsibility of organizing Congresses to an international body, he did not think this argument was as weighty as it might seem to be. It was a settled point of UNESCO's policy not to give grants for the organization expenses of large open international congresses, but only for smaller and more specific projects. He felt that if the general opinion and the vote on Monday next should be against the formation of an International Union under that name, nevertheless some arrangement could be made—and this was the vital thing—for close co-operation with the International Council of Scientific Unions and, through them, with UNESCO and the United Nations.

Mr. A. J. Butler, General Secretary, asked Dr. Needham whether he thought it would be a reasonably adequate mechanism for the Bureau to work in liaison with UNESCO.

Dr. Needham replied that any mechanism that would ensure liaison and contact would be adequate.

The Chairman thanked Dr. Needham for his remarks and his assistance to the Council.

The discussion was closed.

### 6. PLACE OF MEETING OF GENERAL ASSEMBLY—WEDNESDAY, SEPTEMBER 1ST

Mr. A. J. Butler, General Secretary, announced that, in view of the large number of people attending the Congress, it had been considered advisable to change the place of meeting of the General Assembly on Wednesday, September 1st: it would be held in the Royal Albert Hall, and the arrangements would be similar to those for the first General Assembly.

### 7. DELEGATES' MAIL AND COMMUNICATIONS

Mr. A. J. Butler, General Secretary, requested delegates to call more frequently at the Registry to collect their mail and other communications, since a considerable amount was waiting for some delegates.

*The Council adjourned.*

## Fourth Meeting of the Council, 5-30 p.m. on Monday, August 30th

Professor H. H. Read (President) was in the Chair.

Two hundred and ten Members were present.

### 1. MINUTES OF PREVIOUS MEETINGS

The Chairman announced that so far no substantial corrections to the Minutes of previous meetings had been received. A few corrections of names and minor alterations of phraseology would be inserted in the Minutes when printed.

The Minutes were confirmed.

### 2. MEETING OF THE BUREAU OF THE CONGRESS

Mr. A. J. Butler, General Secretary, announced a meeting of the Bureau to be held on Wednesday, September 1st.

### 3. DISCUSSION ON THE QUESTION OF FORMING AN INTERNATIONAL UNION OF GEOLOGY

The Chairman recalled that at its last two meetings the Council had thoroughly discussed this question. He thought it was evident from that discussion that there were two bodies of opinion; some members favoured the setting up immediately of an International Union of Geology, with an orthodox constitution; on the other hand, others would prefer not to form a Union immediately, but to postpone a decision on the matter until the next Session of the Congress. Those members who favoured the second course, however, agreed that in the meantime the Bureau, being a permanent internationally representative body of geologists, should be willing to advise UNESCO on geological matters. Dr. Needham had considered that the second and more cautious approach would be equally satisfactory to UNESCO.



## COUNCIL

He therefore proposed to ask for an expression of opinion, by a vote, on those two propositions, and since the latter was by way of being an amendment to the original proposal, he would put it to the Council first.

Professor V. V. Belousov (U.S.S.R.) said the Soviet delegation found itself in a somewhat difficult position with regard to the proposition to be put first to the Council. It would be prepared to support the first part of the proposal which dealt with the scientific activities of the Bureau, but it was categorically opposed to that part of the proposal which stated that the Bureau should supply information to UNESCO, since if this were done the Bureau would certainly become dependent upon UNESCO and would partly lose its freedom. In the end the Bureau would become practically the same thing as the Union.

Accordingly, Professor Belousov wished to move an amendment to the first proposal put forward by the Chairman. The amendment would recommend the postponement of the decision on this question until the next Session of the Congress, without mentioning anything about the connection of the Bureau with UNESCO. The amendment was seconded.

The Chairman said he was prepared to accept this amendment if it was seconded.

Dr. Richard M. Field (U.S.A.), delegate of the International Union of Geodesy and Geophysics, referring to Professor Belousov's remarks, said that he had just come from the Meeting of the International Union of Geodesy and Geophysics at Oslo. It was most important to have a closer connection between the geophysicists and the geologists, and whether this was achieved by means of a committee of the International Geological Congress or a committee of an International Union of Geology, he did not mind. The important thing was for the geophysicists and other scientists to work together for the benefit of humanity, regardless of politics and ideologies.

Sir Edward B. Bailey (Great Britain) said that he would vote in favour of the proposal including the offer for the Bureau to advise UNESCO, but he wanted to be clear that it was a temporary expedient and that the whole matter would be reconsidered at the next Session of the Congress.

The Chairman then proceeded to put to the Council Professor Belousov's proposal that a decision on the formation of an International Union of Geology be postponed to the next Session of the Congress.

*A vote was taken by show of hands, and the proposal was rejected by 65 votes to 64 votes.*

The Chairman then put to the Council the proposal that a decision on the question of forming an International Union of Geology be postponed, but that the Bureau be prepared to advise UNESCO.

*The proposal was carried by a large majority.*

### 4. DISCUSSION OF THE PLACE OF MEETING OF THE NINETEENTH SESSION

The Chairman reminded the Council that it had before it two invitations, one from the French Government for a meeting in North Africa and the other from the Indian Government for a meeting in Delhi. In opening the discussion, he asked Dr. Blackwelder of the United States delegation whether his delegation had any opinion on the matter.

Dr. E. Blackwelder (U.S.A.) regretted that his delegation had not found time to discuss this important question, and accordingly he had no statement to make on it.

Dr. R. C. Moore (U.S.A.) asked what time of year was foreseen in the two invitations. He had heard it stated that the invitation of the Government of India envisaged the Congress being held in November, and he would like to know to what month the invitation of the French Government applied.

Dr. L. Lutaud (France) replied that the French Government intended that, if the invitation were accepted, the Congress should take place at the end of August and during September. Although it would still be rather warm during those months, that was the best time of the year that could be chosen. It was anticipated that most of the excursions in the Southern part of the country would take place at the end of September.

## PART I : GENERAL PROCEEDINGS

Dr. D. N. Wadia (India) said that the time proposed by his Government's invitation was November and December, which were the two most agreeable months in India.

Dr. L. Lutaud (France) said that, in order to ensure good preparation, it would be safer to agree, if the Council accepted the invitation, that the Session be held in 1952; but if the Council, while accepting the invitation, wished the Session to take place in 1951, France would nevertheless do her best.

Sir Lewis Fermor (Great Britain) said that he supported Dr. Wadia's invitation. The reason the Indian Government were making the invitation now was that such a Session of the Congress would act as a centenary celebration of the foundation of the Geological Survey of India. There was some difference of opinion as to whether the Indian Geological Survey dated from 1846 or 1851, but it was clear that, since the centenary had not been celebrated in 1946, a celebration in 1951 would be appropriate.

From discussions with various members of the Council, he had found that the chief objection to holding the Session in India was that a meeting in November and December would cut into the University terms. That objection would always exist, and if it were allowed to carry weight, there would never be a Session of the Congress in India. In coming to a decision, the consideration which the Council ought to have in mind was that the Session would act as a centenary celebration.

Mr. G. G. Carapiet (India) supported the proposal that the next Session of the Congress be held in India.

Professor L. W. Collet (Switzerland) said that he had been told that at the Seventeenth Session in Moscow, a promise had been given to the French delegation. Was this a fact?

Professor W. T. Gordon (Great Britain) replied that the French delegation had withdrawn their invitation in favour of the United Kingdom invitation. No promise had been made to the French delegation at Moscow.

Professor L. W. Collet (Switzerland), continuing, thought that the Council must vote in favour of accepting the French invitation, a course which he felt sure his friends in India would understand. India was very far away, and he felt that the Council ought to decide to hold the next Session in a country where as many as possible geologists could attend. That would be the situation if the Session were held in North Africa. If it were held in India, it would be attended only by the representatives of the various Governments. Geologists who were not representatives of Governments would not be able to afford the expenses of travelling to India. If the Council decided in favour of holding the next Session in North Africa, it would give the Government of India time to study thoroughly the question of the expenses involved in the Congress.

Personally, he would vote for the French invitation. From what had been said, it seemed to him that what had occurred in Moscow had been almost equal to a promise being given to the French delegation.

The Chairman asked the General Secretary to read the relevant minutes of the Session held in Moscow.

Mr. A. J. Butler, General Secretary, read an extract from the Minutes of the Seventeenth Session of the Congress, as follows:—

“Ch. Jacob pointed out that he made a suggestion that the Eighteenth Session be held in North Africa . . . but in view of the fact that since it was as early as the Sixteenth Session that the English delegation insisted on calling the following Congress in London, he informs that the French delegation will vote in favour of the British invitation.”

Professor O. T. Jones (Great Britain) said that he remembered having many discussions with Professor Jacob at the Seventeenth Session and the French delegation had finally withdrawn their invitation in favour of the United Kingdom invitation. He could not remember that there had been any promise made, and he was a little doubtful whether the Council at that time would have made a definite promise, since he supposed that one Session of the Congress could not bind another Session.



He asked if the French delegation had considered the possibility of holding the Session in the Spring.

Professor L. Lutaud (France) said it was desirable for the Congress to meet during holiday time. It was felt that if the Session were held at the end of August and during September, it would be attended by more geologists from the Universities, and more students would be able to come. There were many things to show in North Africa. The work had been going on for fifty years, and it was now ready to be shown and discussed. In asking the Council for a postponement from 1951 to 1952, he had not done so because the geological work was not ready; he had done so because, after the war, there was a great deal of reconstruction to be done.

Professor P. F. J. Fourmarier (Belgium) reminded the Council that at the Seventeenth Session the French delegation had withdrawn its invitation in favour of the United Kingdom invitation. He hoped that the Indian delegation would now make the same courteous gesture to the French delegation. If it did so, he was certain that that action would be borne in mind when, at the next Session of the Congress, the place of meeting of the following Session was decided upon. The Belgian delegation would vote in favour of accepting the French invitation.

Mr. P. Evans (Great Britain) representing the Geological Society of India, said that the centenary of any Geological Survey was a very great event. European officers had very largely built up the Indian Geological Survey. They had now passed on their mantle to the Indian geologists. The aim of the Congress was to contribute to the advancement of investigations relating to the study of the earth. He asked what better way there was of doing this, what better celebration of an important centenary, and what better way of giving encouragement to geologists facing new responsibilities, than to hold the next Session of the Congress in India?

Professor V. V. Belousov (U.S.S.R.) said that both the invitations before the Council were very interesting, and it was very difficult to make a choice between them. He felt that it was right to give priority to the invitation that had been made first, and that was the French invitation, which had been extended to the Council at the Seventeenth Session. The Soviet delegation would accordingly vote in favour of accepting the French invitation.

He hoped very much that the Indian Government's proposal would again be put to the Congress for its Twentieth Session. He fully understood the desire of his Indian colleagues to have the Session in Delhi to mark the centenary celebration of the Geological Survey of India, but one hundred years was a long enough time to permit of the postponement of the actual celebration for a further three years.

Dr. B. Sahni (India) said that he fully recognized the difficult choice which was before the Council. He rose, not to speak in favour of the Indian invitation, but to suggest that they ought to know clearly the principle on which these important matters were decided. If it was to be the case that all invitations were to be considered and accepted in the order in which they were presented, it would become quite easy for India to say that she would wait three years longer for the International Geological Congress to be held in Delhi—and when the Congress did come to India, it would be regarded as a great honour by India.

The international nature of the Congress must always be borne in mind, and questions of distance should not be allowed to govern the decision of the Council on the place of meeting.

He did not wish to press the Indian invitation, because he felt that the case for the French invitation which had been made by Dr. Lutaud and Professor Fourmarier was a very strong one. He felt that at the Seventeenth Session at Moscow, at which he had not been present, there had been, if not a promise, at any rate an understanding, and the French delegation had yielded to the United Kingdom delegation. He hoped that the representative of India, Dr. Wadia, would not press the Indian Government's invitation. It would be very awkward for many friends of India to vote on a question of this sort.

Personally, he would only say that whenever the International Geological Congress did India



the honour of a visit, Indian geologists would count it a privilege to do everything possible to make the visit interesting and useful.

The Chairman asked Dr. Wadia whether he wished to say anything with regard to Dr. Sahni's remarks.

Dr. D. N. Wadia (India) replied that, much as he approved of Dr. Sahni's attitude, unfortunately he was not empowered by the Government of India to withdraw the invitation. He was not in a position to consult his Government, and he could not withdraw the invitation without being definitely empowered to do so.

*A vote was taken by show of hands, and the Council decided to accept the French Government's invitation.*

The Chairman said that, in accepting the invitation of the French Government, he felt sure that the Council would be very anxious to convey to the Government of India, through Dr. Wadia, its thanks for their invitation. He expressed the hope that the Twentieth Session of the Congress might be in India.

Dr. L. Lutaud (France), on behalf of the French Government and all French geologists, thanked the Council for accepting the French invitation.

#### 5. RECEPTION OF REPORTS FROM THE COMMISSIONS OF THE CONGRESS

(a) *Spendiarov Prize*: Sir Edward B. Bailey (Great Britain) reported that the Commission, after careful consideration, had decided to recommend that the Prize be awarded to Professor L. R. Wager for his distinguished contribution to knowledge of East Greenland and the Himalayas.

*The recommendation was adopted.*

(b) *Lexicon of Stratigraphy*: Sir Lewis Fermor (Great Britain), in the absence of the President of the Commission, said that he was not empowered to act on behalf of the Commission, but he was aware of the general recommendations, which he felt sure the Council could adopt.

*The recommendations were adopted.*

(c) *Crust of the Earth*: Professor P. Fourmarier (Belgium) reported the recommendations of the Commission, which were adopted.

(d) *Geophysics and Geothermics*: Sir Edward B. Bailey (Great Britain) said that he had sought to ascertain whether there was a strong desire to continue this Commission. Although certain members had been desirous of continuing it, the general opinion had been that it should be discontinued.

*This was agreed.*

(e) *Geological Map of Europe*: Professor A. Renier (Belgium) reported that the Commission had held only one meeting, for the purpose of electing members to replace those who had died.

*The Report of the Commission was adopted.*

(f) *Geological Map of the World*: Monsieur F. Blondel (France) reported the following recommendations by the Commission: (1) That the members of the Commission no longer be elected by name, but that the Commission should consist of the Directors of the Geological Surveys of the various countries. The Commission would, however, add to its numbers certain persons whom it considered to be specially competent. (2) That it did not for the moment seem desirable to elect a new President. (3) That the present Vice-President would be charged with the task of summoning the Commission as soon as circumstances appeared more favourable. For this first meeting, the Vice-President would invite, after proper consultations, the members who would be additional to the Directors of the Geological Surveys. (4) That at the forthcoming meeting the Commission would examine the possibilities and means of picking up the threads of its previous work.

*The recommendations were adopted.*

(g) *Distribution of the Gondwana (Karoo) System*: Professor L. Hawkes, General Secretary, reported that all the former members of the Commission were now dead, and it had been decided to leave the matter of the re-election of a Commission in the hands of the Bureau.

*This was agreed.*

## COUNCIL

(h) *International Geological Map of Africa*: Dr. F. Dixey (Great Britain) said that the question of the report of the Commission on the International Geological Map of Africa had been taken as part of the work of the Association of African Geological Surveys. He then reported the recommendations of the Commission, *which were adopted*.

Sir Edward B. Bailey (Great Britain) expressed thanks to Monsieur F. Blondel for his excellent services as Secretary.

(j) *Authors' Abstracts*: Professor W. T. Gordon (Great Britain) presented the Commission's recommendations, *which were adopted*.

The Chairman, in view of the lateness of the hour, asked those members of the Council who were to have presented reports from the Temporary Commissions and Committees set up during the present Session whether they would agree to present their reports at the meeting of the General Assembly on the following day. He also asked Professor Pruvost if he could agree to the same procedure with regard to the report of the International Paleontological Union.

*This was agreed.*

### 6. MINUTES OF THE PRESENT MEETING

The Chairman asked the Council to agree to entrust the confirmation of the Minutes of the present Meeting to the Bureau.

*This was agreed.*

### 7. CONCLUSION OF COUNCIL MEETINGS

The Chairman said that the items on the agenda which had not been dealt with having been passed to the General Assembly, the Council's business had now been completed. He wished very heartily to thank members for the work they had done.

*The Council rose.*

## PROCEEDINGS OF THE BUREAU

Meeting at 2-15 p.m. on Wednesday, September 1st

Professor H. H. Read (President) was in the Chair.

The following were among those present:—

A. J. Butler, L. Hawkes (General Secretaries).

F. N. Ashcroft (Great Britain)	C. K. Howse (Newfoundland)
M. I. Attia (Egypt)	A. R. Lamego (Brazil)
E. B. Bailey (Great Britain)	J. S. Lee (China)
C. Barrington Brown (British Guiana)	L. Lutaud (France)
V. V. Belousov (U.S.S.R.)	W. F. P. McLintock (Great Britain)
G. A. Bétier (Algeria)	K. Metz (Austria)
L. V. Čepék (Czechoslovakia)	H. Ödum (Denmark)
Léon W. Collet (Switzerland)	H. G. Raggatt (Australia)
C. P. A. Zeijlmans van Emmichoven (Netherlands East Indies)	C. H. L. Sirimanne (Ceylon)
P. F. J. Fourmarier (Belgium)	A. G. A. Sutton (Trinidad)
S. H. Haughton (South and South-west Africa)	E. O. Teale (Tanganyika)
E. Homayounfar (Iran)	D. N. Wadia (India)

### 1. MINUTES OF FINAL MEETING OF THE COUNCIL AND SECOND AND THIRD MEETINGS OF THE GENERAL ASSEMBLY

The Chairman said that the Minutes of these meetings had been circulated and asked the Bureau to approve of them, subject to any minor amendments which might be notified to Mr. Butler.

*The Minutes were approved, subject to this condition.*

### 2. PRESERVATION OF NATIONAL GEOLOGICAL RESERVES

Mr. A. J. Butler, General Secretary, recalled that the Council had instructed the Bureau to communicate a recommendation on this subject to the Governments represented at the Congress. He suggested that a paper summarizing the discussion at the Council meeting should be forwarded to heads of National Delegations, with a request that they should transmit it to their Governments.

Dr. S. H. Haughton (Union of South Africa) thought it might be of interest to the Bureau to know the steps which the Government of South Africa had taken with regard to this matter. A good many years ago there had been set up in South Africa a Commission for the Preservation of Historical and Natural Monuments, and these natural monuments were taken to include objects of geological interest. Several such objects had already been proclaimed as national monuments. As a member of the Commission, he had taken steps to ask all geologists in South Africa to prepare a statement of the objects which they considered ought to be proclaimed as national monuments. That list was now in course of preparation and would be submitted in due course to the Commission. If the Commission agreed to the list, the objects would be proclaimed as national monuments by the responsible Minister.

Dr. H. Ödum (Denmark) drew attention to the fact that several countries already had very strict legislation on this subject. In Denmark, for instance, any geological sites containing phenomena of interest could at any time be made subject to protection. He wondered whether it would be of any assistance to the Bureau to have information on such legislation.



Professor V. V. Belousov (U.S.S.R.) said that, in view of the fact that legislation already existed in certain countries, particularly in the U.S.S.R., where the Government took a great interest in and gave great assistance to this aspect of the work of geologists, he thought it would be advisable to make the appeal only to those Governments where it was necessary to do so.

The Chairman thought that a useful document could be compiled on the lines suggested by Mr. Butler, and that the additional examples given by Dr. Haughton, Dr. Ödum and Professor Belousov could be included to strengthen the case for submission to those Governments which were not taking similar action.

Dr. H. G. Raggatt (Australia) agreed with Professor Belousov that the document ought not to be sent to countries which were already doing such things. He could not speak for the whole of Australia, but he was sure that certain States of the Commonwealth had already proclaimed reserves of this kind—and possibly all of them had done so.

Dr. W. F. P. McIntock (Great Britain) thought that this point could be left to the discretion of the Government delegates to whom the document would be circulated.

The Chairman interpreted the opinion of the Bureau to be that a document on the lines suggested should be prepared and sent to the Government delegates; if those delegates felt that their Governments were already conforming to the recommendation, they would not transmit the document to their Governments; if, on the other hand, they saw the chance of taking some useful action, they would do so.

*This was agreed.*

### 3. REVIVAL OF CERTAIN JOURNALS OF ABSTRACTS

Mr. A. J. Butler, General Secretary, recalled that at the second meeting of the Council, Dr. Schürmann, on behalf of the Netherlands Geological and Mining Society, had presented a recommendation that the Congress should attempt to promote the revival of certain Journals of Abstracts. After some discussion, the Minutes recorded that the Council felt that the Bureau should be instructed to study the general question of geological abstracting, taking into account the remarks made in the Council.

Professor L. Hawkes, General Secretary, informed the Bureau that the *Neues Jahrbuch* hoped to resume publication this year, and the editor asked for moral support.

Dr. W. F. P. McIntock (Great Britain) did not think it was feasible for the Bureau to formulate a definite plan until the respective countries were publishing normally and exchanging publications normally.

Mr. A. J. Butler, General Secretary, suggested that if any member of the Bureau saw an opportunity for any useful action in which even the moral support and encouragement of the Bureau might be of use, he should let the Secretariat know so that the information could be passed on to the other members of the Bureau.

Dr. S. H. Haughton (Union of South Africa) asked members to pay attention to the Report of the Commission on Authors' Abstracts which had been placed before the Council by Professor Gordon. That Report had urged that in every country steps should be taken to ensure that every geological paper that was published should be accompanied by an abstract written by the author, and that if that abstract was not in one of the official languages of the Congress, it should also be accompanied by an abstract in one of the official languages. If that scheme were adopted in every country, it would be a very much simpler matter for some central organization to collect those abstracts and distribute them.

The Chairman invited members of the Bureau to urge the adoption of that principle in their countries.

Sir Edward B. Bailey (Great Britain) thought it might be better for the Secretary to make a definite request to the societies in the various countries, although the delegates of those countries should be informed that it was being done.

## PART I: GENERAL PROCEEDINGS

Professor V. V. Belousov (U.S.S.R.) agreed with Dr. Haughton's remarks. He felt that the Bureau should be careful, however, about giving moral or other support to proposed publications in various countries. In all countries which had suffered during the war, there were difficulties with printing. He thought that the suggestion that the Bureau give moral support to the *Neues Jahrbuch* ought to be rejected.

Mr. A. J. Butler, General Secretary, asked whether at this point the Bureau could record its agreement with Dr. Haughton's suggestion that members should take any action they could to promote the production of authors' abstracts in the official languages of the Congress; and that if any other means of improving the system of abstracting occurred to members, they should inform the Secretariat, who would disseminate the information to other members of the Bureau. With regard to Sir Edward Bailey's suggestion, it would be helpful if members would submit to the Secretariat lists of institutions to whom they would like the communication to be sent.

The Chairman interpreted the opinion of the Bureau to be in agreement with the proposals made by Mr. Butler.

*This was agreed.*

### 4. COMMISSION ON THE DISTRIBUTION OF THE GONDWANA (KARROO) SYSTEM

Dr. S. H. Haughton (Union of South Africa) reminded the Bureau that this Commission had been set up at the Fifteenth Session of the Congress in South Africa in 1929. At the Seventeenth Session in Moscow, the Commission had agreed that attempts should be made to investigate particularly the climatic conditions under which the various members of the Gondwana or Karroo System had been deposited. Unfortunately the war had intervened, and very little information had been obtainable in time for the present Session. As Secretary of the Commission, he had compiled a report from the literature that had been published, and included in that report documents which had been sent to him by Indian, Australian and Madagascan geologists.

At the meeting of the Commission which had been held two days ago, only two members had been present. The Commission consisted of the Directors of various Geological Surveys in the area which contained the Gondwana System, together with four other nominated members, one of whom was the Chairman. All four nominated members were now dead, so that the Commission was without a Chairman, and he regretted to say he would not find it possible to carry on as Secretary. The two members of the Commission who had been present at the meeting had therefore decided to leave the whole matter to the Bureau.

He suggested that the Commission was of sufficient importance to justify its continuance, but he proposed that new officers be appointed by the Bureau.

Dr. D. N. Wadia (India) supported Dr. Haughton's proposal that the Commission be continued and that new officers be appointed. The world had still much to learn about the physiography and climatology of the Gondwana System which was so widespread throughout the world, and it would be a pity if the Commission were allowed to die.

Dr. H. G. Raggatt (Australia) said that in Australia there were very large areas occupied by representatives of this system and a great deal of active work was going on in areas so occupied. Australia would be glad to do what it could to see that the Commission was continued.

Dr. Lamego (Brazil) supported Dr. Haughton. The Gondwana System was very important in the South of Brazil.

The Chairman invited the representatives of the Gondwana lands to suggest personnel for the Commission.

Dr. S. H. Haughton (Union of South Africa) asked Dr. Wadia whether he would be prepared to accept the Presidency of the Commission.

Dr. D. N. Wadia (India) said that he would prefer not to accept the office, but he would be ready to serve as a member of the Commission.

Dr. Lamego (Brazil) thought it would be suitable if Dr. Haughton himself became President of the Commission, since South Africa was at the centre of the Gondwana lands.

Dr. H. G. Raggatt (Australia) suggested that Dr. Curt Teichert, of Melbourne University, a very active worker in this field, might be prevailed upon to act as Secretary.

The Chairman summed up the proposals:—Dr. Haughton to be President, Dr. Teichert to be Secretary (subject to his agreement); Dr. Wadia to be a member of the Commission. In addition, Professor Belousov had previously proposed M. F. Neuburg as representative of the U.S.S.R. on the Commission.

In reply to an enquiry from Dr. J. S. Lee (China) the Chairman mentioned that the Director of the Geological Survey of China would be a member of the Commission.

*The proposals were agreed.*

##### 5. COMMUNICATION FROM DR. D. SCHNEEGANS AND DR. WEGMANN CONCERNING THE ORGANIZATION OF FUTURE SESSIONS

Mr. A. J. Butler, General Secretary, read the following letter from Dr. Schneegans and Dr. Wegmann concerning the organization of future Sessions:—

“Monsieur le Président,

Nous avons l'honneur de vous soumettre la motion suivante et nous vous prions de vouloir bien la soumettre à l'Assemblée des délégués:—

Certains auteurs de communications ne se sont pas rendu compte du rôle des Congrès internationaux. Ils se sont efforcés d'attirer l'attention de leurs collègues sur des points de détail dont la plupart des auditeurs n'ont été en mesure de déterminer ni la portée ni la valeur scientifique. Afin de ne pas disperser l'attention des auditeurs sur une multitude d'observations locales, nous proposons de donner la forme suivante au programme des Congrès futures:—

- (1) L'état d'avancement de nos connaissances concernant les problèmes mis à l'ordre du jour des Congrès, serait l'objet des rapports généraux ou *symposiums* dont la préparation serait faite durant l'année précédant le Congrès par une réunion de spécialistes. Les résultats de ce travail serait l'objet des discussions pendant le Congrès.
- (2) Une place plus grande serait donnée aux communications essentielles qui seraient exposées sous la forme de conférences.
- (3) Toutes les autres communications seraient ronéotypées avant le Congrès et leur lecture et mise en discussion en séance pourraient être faites sur la proposition de 5 membres de la section. Leur publication dans le compte rendu du Congrès serait assurée comme par le passé.
- (4) La réalisation de cette motion serait étudiée par la Commission exécutive du Congrès.

*Remarques finales.*—Dans l'établissement des mises en points ou symposiums les rapporteurs devront montrer un esprit critique averti mais impartial, ils auront à se dégager de tout préjugé d'école et de tout dogmatisme, leur rôle étant de retenir des idées et des thèses marquant un progrès dans la science, mais non pas barrer la route aux esprits originaux sortant des sentiers battus de la tradition.

Un tel effort de coopération entre chercheurs de toutes les nations rendrait la préparation scientifique des Congrès futures plus effective, les séances des sections seraient plus vivantes et plus profitables, à la fois, pour les spécialistes et pour les géologues venus de tous les horizons de la terre pour suivre le progrès de notre science.

E. WEGMANN.

D. SCHNEEGANS.

Veuillez agréer, Monsieur le Président, l'expression de notre gratitude pour l'intérêt que vous voudrez bien porter à la lecture de la présente motion.

The Chairman, while expressing the opinion that some excellent proposals were contained in the document, thought the matter was one primarily for the French delegation.

Professor L. Lutaud (France) said that he knew of the proposals contained in the letter. He thought some useful proposals were contained in its first part. It was a fact that in some Sections, even at the present Congress, papers were read which had not a very wide interest.

The idea behind the proposals was that, although there was no desire to prevent people from presenting papers which might afterwards be printed in the Records of the Congress, there was not time in the Sections to listen to the reading of papers and discussions upon them which were of interest only to two or three people.



On the other hand, as had been demonstrated at the Brussels Congress, there might be an opportunity to hear a very important paper; he was thinking of the paper by Argand on "The Tectonics of Asia." The Bureau of the Brussels Congress had understood the very high importance of that paper, and it had been presented in a general lecture and not at a Section meeting.

The rule in the French Geological Society was that when a person submitted a paper to be printed in the Bulletin of the Society, only the title of the paper was read out at the meeting as a general rule. The paper was read in full only if a certain number of members present asked for that to be done. That was the suggestion that was made in the letter, and he thought it was a good one.

It would, of course, be a heavy responsibility upon the Bureau of the International Geological Congress if it had to say that a certain paper would not be read unless, say, five members asked for it to be read. No Bureau would take such a decision unless definite rules to that effect were drawn up.

He thought the proposals contained in the letter were worthy of consideration and that the Bureau ought to examine the matter during the next two or three years. It might then be possible to propose a rule that would be acceptable to the next Session of the Congress.

Mr. A. J. Butler, General Secretary, wished to make four points, based upon his recent experience. First, there was a recommendation in the letter that there should be more symposia. There had been one symposium at the present Session. It had been successful and he was sure it would be a good thing to have more.

Secondly, there was a suggestion that greater opportunity should be given for essential information to be communicated in the form of lectures. At the present Session there had been two special lectures by Sir Edward Bailey and Professor Jones. He thought it would be a good thing to extend this activity, if time could be found.

Thirdly, there was a point about all papers being circulated before the Congress Session—he thought this would in practice be extremely difficult. Eighteen months ago, May 14th had been set as the last date for the receipt of abstracts of papers, and up to three weeks before that date he had received only about six abstracts. He had then sent out 250 air-mail letters of reminder and had received about 150 abstracts slightly before the set date and a similar number in the following three or four weeks, just in time to get them printed. But even to the present, abstracts were still arriving. He could not see how it would be possible to assemble from all parts of the world not only abstracts but full papers, and to get them circulated beforehand.

Fourthly, there was a proposal that the implementation of the recommendations in the letter should be studied by the Executive (*i.e.*, the Council) of the Congress. The task of the Organizing Committee or Executive Committee before the Session was sufficiently complicated and difficult, and he thought it would be a bad thing if they had hanging over them any fear of an inquisition by the Council. The proposals in the letter could be passed on to the next Organizing Committee as worthy of their sympathetic consideration, but he did not think that Committee ought to be bound by any rigid instruction from the Bureau.

Sir Edward B. Bailey (Great Britain) said that all through his scientific life there had been symposia, there had been lectures on specific subjects, and there had been papers left unread and yet published. He did not think any additional rules were required, since all the powers obviously existed already. All that was required was that the Bureau should encourage the Organizing Committee to exercise perhaps a little ruthlessly what powers it had in the way it saw fit.

Professor V. V. Belousov (U.S.S.R.) said that there were some very interesting proposals in the document that had been read to the Bureau. The document was, however, drawn up in rather a poetic form, whereas what Professor Lutaud had suggested had been expressed in a more practical manner. It would, he thought, be best to ask the Organizing Committee of the next Session to circulate its own proposals with regard to that Session as soon as possible. After that had been done, members of the Bureau could think about these proposals and perhaps suggest some modifications or improvements.

The Chairman thought it would be unwise for the Bureau to dictate to the Organizing Committee

of the next Session how it should organize the Session. He proposed that the Bureau should ask the Organizing Committee to note and consider the suggestions contained in the document and the suggestions that had been made by members of the Bureau.

*The Chairman's suggestion was agreed.*

#### 6. COMMUNICATION CONCERNING A MEETING ON GEOMORPHOLOGY

Mr. A. J. Butler, General Secretary, read a communication from Dr. J. Bourcart and Dr. A. Hacquaert concerning a meeting of members interested in the progress of geomorphology, which had been held during the Session.

The Chairman, in asking the Bureau to take note of the communication, suggested that copies should be circulated.

*This was agreed.*

#### 7. ADVICE TO BE GIVEN TO UNESCO BY THE BUREAU

Mr. A. J. Butler, General Secretary, said that the Council had agreed that the Bureau should be prepared to advise UNESCO. What the Bureau could do would obviously be limited by considerations of time and labour, but the matter might prove to be a good deal simpler than some of them had thought.

Although members of the Bureau were, of course, themselves well aware of the existence of national Geological Surveys and societies, and of the organizations of geological workers in general, the authorities of UNESCO were probably not acquainted with these facts. UNESCO's main need was probably some central authority to which it might apply for information of this kind. It would be a relatively easy matter for the Secretariat to put UNESCO in touch with experts suitable to advise on specific problems.

The Chairman thought the Bureau would be well able to take care of itself and to preserve its independence.

Professor V. V. Belousov (U.S.S.R.) said that the opinion of the Soviet Delegation on the matter now under consideration by the Bureau had already been expressed by him. As these recommendations had been accepted, however, he felt obliged to state once again that neither he, as a member of the Bureau, nor the geological institutions of the Soviet Union, which he represented, could undertake obligations in connection with UNESCO.

The Chairman envisaged two kinds of enquiries from UNESCO to the Bureau. First, there would be those which could be answered simply by the Secretariat. Secondly, there might be bigger and more involved enquiries, and those, he thought, if they arrived, should be submitted by the Secretary to the members of the Bureau for their comments and for the formulation of a policy.

Sir Edward B. Bailey (Great Britain) suggested that, so far as published information existed, the Bureau might give an answer regarding any part of the world. But the Bureau should be careful not to give any unpublished information in regard to such countries as wished to stand out of the arrangement.

The Chairman said that he did not think it was the function of the Bureau to assemble information, but simply to say where it could be found.

Dr. W. F. P. McLintock (Great Britain) said that the Bureau was bound by the Minute of the Council, and he took it that the present discussion related to the extent to which the Bureau was prepared to implement that Minute. The Minute said distinctly that the Bureau should be prepared to advise UNESCO. That being so, the Bureau must advise UNESCO in so far as it could and in so far as its judgment would allow it to do so.

Sir Edward B. Bailey (Great Britain) said that the essential qualification was "in so far as its judgment allowed it."

The Chairman asked members whether they were prepared to leave the matter in that way, since there was clearly a general idea as to how the Bureau should proceed.



Sir Edward B. Bailey (Great Britain) asked that action on any point touching upon the Soviet Union should not be taken until the Soviet Union had been consulted.

The Chairman replied that any action taken in regard to any country, unless it was a plain piece of information which was clear to everybody except UNESCO, would be considered by the whole Bureau.

*The Bureau agreed to proceed on the lines indicated in the discussion.*

#### 8. COMMUNICATION CONCERNING UNITED NATIONS SCIENTIFIC CONFERENCE ON CONSERVATION AND UTILISATION OF RESOURCES

Mr. A. J. Butler, General Secretary, read a letter from the Secretary of the Preparatory Committee of the United Nations Scientific Conference on the Conservation and Utilisation of Resources, as follows:—

Dear Sir,

I am writing you on behalf of the Preparatory Committee of the United Nations Scientific Conference on the Conservation and Utilisation of Resources to explore the possibility of the International Geological Congress assuming the responsibility for preparation of one of the most important introductory papers at the Conference. The topic on which the Congress would be invited to prepare a paper is *a world survey of critical shortages of minerals*. You will note from the attached revised programme (page 3, Plenary Meeting 3) that in addition to the minerals paper, critical surveys of shortages of food, forest products, and fuels and energy will also be presented to this meeting. The first two of these subjects will be dealt with by the Food and Agriculture Organization of the United Nations, and the World Power Conference is being invited to prepare a paper on the last of these two topics.

These papers will survey the critical shortages in their fields, present and potential, and will discuss the function of significant techniques to overcome these shortages and their potentialities.

I am writing you in this exploratory manner, in advance of the official invitation to be issued by the Secretary-General, in order that this matter may be considered at the present meeting of your Congress in such manner as you may deem appropriate. May I hope to receive your reaction to this proposal in order that I may inform the Preparatory Committee and proceed with the issuance of a formal invitation?

This inquiry, he said, was a difficult one in its general application, but there were two or three things which could be done immediately. The reply could be given that the Congress had made no survey of critical shortages of minerals in general, but had completed a symposium of the reserves of two particularly scarce minerals, the ores of lead and zinc. Reference could also be made to the past volumes of the Congress on mineral resources, which would give some indication of present world supplies. For the rest, one could only circularize members of the Bureau telling them that contributions from their individual countries would be welcomed by the Preparatory Committee. Beyond that it would not be possible to go.

The Chairman said that this seemed to be a straightforward example of how these enquiries could be dealt with.

Dr. H. G. Raggatt (Australia) said that in the Commonwealth they were accustomed to dealing with this kind of problem on a smaller scale with the States. He suggested that in dealing with questions of this kind, the members of the Bureau should be advised of the terms of any reply which it was proposed to send, because quite frequently correction would be necessary for the reason that practice was far ahead of publication. During the present Session he had had occasion to look at a paper which had been presented to an American conference on world coal resources, and the map of Australian coal resources had been very inaccurate.

The Chairman thought that all members of the Bureau would require that any major problem must be referred to the whole of the members of the Bureau before the Bureau was committed to any reply.

*This was agreed.*

#### 9. CO-ORDINATION OF MEASUREMENTS

Dr. H. Ödum (Denmark) said that a problem to which he wished to refer was a very real one to those who had not been born in an English-speaking country. He had attended meetings at the present



Session where all the measures had been given in feet and inches instead of in metres; all weights had been given in pounds and not in kilograms, all pressures given in pounds per square inch and not atmospheres.

When reading a paper, he could make all the necessary calculations himself, but he could not do it quickly when listening to a speaker. It was impossible for many people to take part in the discussions because they could not get to the bottom of the statistical data. It would be of great assistance if a circular were issued from the Bureau to all authors, and especially to all editors of periodicals, asking them to give the metric measurements in brackets.

The Chairman suggested that this was a matter which members could take up themselves and that they might reform the practice in the Congress. He thought the Bureau might ask whoever was responsible for the publication of the proceedings of the present Congress, to see that the measurements were given in both the metric and the other system.

Dr. S. H. Haughton (Union of South Africa) observed that this had been done at the Fifteenth Congress.

Dr. W. F. P. McLintock (Great Britain) agreed entirely with Dr. Ödum's suggestion, but suggested that when the Congress went to countries where the metric system was in use it would be helpful if they would publish their statistical data both in the metric and the Anglo-Saxon systems.

Sir Edward B. Bailey (Great Britain) said that the rule ought to apply also to the abstracts which societies were being asked to write, as well as to papers.

The Chairman said he felt that there was general agreement with Dr. Ödum's suggestion.

*The Bureau rose.*

## PAPERS RELATING TO THE PROCEEDINGS OF THE BUREAU

### 1. NOTICE CONCERNING GEOMORPHOLOGY

*(A notice circulated after the Session to the Heads of National Delegations, in accordance with Paragraph 6 of the Minutes of the meeting of the Bureau on September 1st, 1948.)*

Those members of the Eighteenth Session of the International Geological Congress interested in the progress of geomorphology, met on Monday, August 30th, 1948, at the Geological Survey and Museum in London. Nine countries were represented by 21 delegates.

Monsieur Jacques Bourcart indicated the aims of the promoters of this meeting: To establish an international review devoted to the study of geomorphology and quaternary and also to the study of sediments and sedimentation. By this method the contacts made during the meetings at Ghent and Brussels in 1946, at which only France, Belgium, Holland and Sweden were represented, would not only be continued but enlarged.

Various similar suggestions were received from different quarters and it therefore seemed necessary to concentrate on establishing an international review in which all the official languages of the Congress would appear, and which would replace the French, American and German review which necessarily disappeared during the war.

M. Bourcart suggested that the review could be subdivided and different numbers could be published devoted to different subjects.

The question was, whether it was a good thing to create an International Geomorphological Union similar to the International Paleontological Union; whether that Union should be organized before publishing the review or, on the contrary, whether the review could be launched independently of the creation of the Union. This last alternative seemed to be the most practical, since the Union could at the earliest be organized in time only for the next session of the International Geological Congress.

## PART I: GENERAL PROCEEDINGS

In the opinion of the members present the early publication of a review appeared desirable and all the countries represented at the meeting assured the promoters of the project of their support.

It was unanimously agreed that the publication should be confined either to Holland or to Belgium. As from the date of the meeting, a limited committee would be charged with the formulation of a definite project.

All suggestions in connection with this project would be gratefully received at the address of the temporary secretary:—Professor A. Hacquaert, Institut de Géologie de l'Université de Gand, Rozier 6 (Belgium).

J. BOURCART,  
A. HACQUAERT.

### 2. MEMORANDUM AND RECOMMENDATION ON NATIONAL GEOLOGICAL RESERVES

*(Sent after the Session to the Heads of National Delegations to the Eighteenth Session, in accordance with a decision of the Bureau at its meeting on September 1st, 1948.)*

1. In several countries legislative or administrative action has been taken, or is being prepared, to conserve and protect specified districts, features and rock-exposures which are of particular geological importance.

In many other countries, however, geologically important areas, features and exposures are in constant danger of being destroyed or rendered inaccessible by building or other development schemes, by quarrying operations or by the dumping of waste.

2. The Council of the Eighteenth Session of the International Geological Congress, at a meeting held on August 25th, 1948, unanimously agreed strongly to recommend, to the Governments of all countries in which no adequate steps for the preservation of Geological Reserves have yet been taken, that in each country a national list of geological sites of outstanding scientific or educational importance shall be prepared, and that legislative action shall be taken to safeguard these sites and to secure reasonable access to them.

This recommendation was ratified by the General Assembly of the Congress on August 30th; and has thus the agreement and support of a body of over 1,750 geologists representing some 76 countries.

3. During the discussions of the Council and Bureau the following examples of existing or prospective legislation were recorded:—

*Australia:* Certain geological reserves have already been proclaimed.

*Denmark:* Strict legislation already exists, by which any geological site containing phenomena of special interest may be brought under protection.

*England and Wales:* A Nature Reserves Investigation Committee has prepared detailed lists of proposed Geological Reserves, classifying these into (a) Conservation Areas (Geological): large-scale physiographic features and areas containing many items of geological interest, (b) Geological Monuments: small-scale geological features and sections of outstanding interest, (c) Controlled Sections: natural sections, and artificial sections in a state of disuse, (d) Registered Sections: sections of exceptional geological importance at present used or worked. The Committee has made precise recommendations for the control and preservation of these Reserves, and it is understood that the British Government has accepted the recommendations in principle.

*Union of South Africa:* A Commission for the Preservation of Historical and National Monuments has already proclaimed as national monuments certain sites of geological interest. All geologists in South Africa have been asked to assist in the preparation of a more comprehensive list of geological sites and features worthy of preservation, and this list is to be submitted to the Commission.

*Union of Soviet Socialist Republics:* Legislation for the protection of important sites and features is already in existence and in use.

4. At a meeting of the Bureau of the Congress on September 1st, 1948, it was agreed that this Memorandum be sent to the Heads of all National Delegations at the Congress. The Bureau requests

## BUREAU

that in the case of each country where legislative action is desirable and has not already been taken, the Head of the Delegation of that country shall transmit the Memorandum to his Government.

A. J. BUTLER, *General Secretary*.

### 3. ABSTRACTS OF GEOLOGICAL PAPERS

*In consequence of the discussion recorded in Paragraph 3 of the Minutes of the meeting of the Bureau held on September 1st, 1948, copies of a printed leaflet with the following text were sent to the Heads of all National Delegations, with a request that they should distribute them appropriately within their countries:—*

The Bureau of the International Geological Congress wishes to bring to the notice of all editors and publishers of geological journals the following recommendations:—

(1) That wherever possible publishing authorities should insist, in every country, that the author of a paper be required to furnish an abstract of the paper submitted for publication.

(2) That such abstract may be in the native language of the author, but that a translation of the abstract in at least one of the official languages of the Congress should, however, be provided.

These recommendations, made by the Commission on Authors' Abstracts (a Commission of the Congress), were agreed by the Council and General Assembly of the Eighteenth Session. They have, therefore, the support of geologists representing some 76 countries.

The official languages of the Congress are English, French, German, Italian, Russian and Spanish.

The Bureau urges that all journals which have not yet adopted the practice which is recommended shall do so as soon as possible. The abstract of a paper should be printed with the paper, preferably at its head.

A. J. BUTLER, *General Secretary*.



# PROCEEDINGS AND REPORTS OF COMMISSIONS OF THE CONGRESS

## Joint Meeting of Members of Commissions

A joint meeting of members of the Commissions of the Congress present at the Session and of other interested persons was held in the Lecture Theatre of the Royal Geographical Society on Thursday, August 26th, at 9 a.m. Professor H. H. Read (President) was in the Chair.

The Chairman, in opening the meeting, explained that its purpose was to examine the state of each Commission after the lapse of years since the Seventeenth Congress and decide whether to reorganize the Commission, strengthen it or allow it to die a natural death. He proposed that the Commissions should be dealt with in the order in which they were printed in the Handbook of the Seventeenth Session. After the long break which had occurred, it might be impossible to get all Commissions working in the short time available at the present Congress. In any case, the work of any Commission would depend upon the energy of the President and the Secretary, and an endeavour must be made to find such Presidents and Secretaries at the present meeting if the Commissions were to function properly. He thought it might be better to give full life to a few of the Commissions rather than to resuscitate all of them, with the possibility that some of them would not do any useful work.

### SPENDIAROV PRIZE

The Chairman reported that Sir Edward Bailey, the President of the Commission, and Professor Belousov had been asked to co-opt two or three other members to complete the Commission. Professor Belousov had proposed, on behalf of the Soviet delegation, that a British geologist be considered as the recipient of the Spendiarov Prize. On behalf of British geologists, he wished to thank Professor Belousov and the Soviet delegation for their generous action.

Professor V. V. Belousov (U.S.S.R.) said that he and Sir Edward Bailey would complete the composition of the Commission and convene it as soon as possible.

*This procedure was agreed.*

### LEXICON OF STRATIGRAPHY

Dr. S. H. Haughton (South Africa) said that during the period which had elapsed since the last Congress, little had been done, to his knowledge, with regard to the production of the Lexicon of Stratigraphy. He had discussed the matter with Sir Lewis Fermor, who had given the information that the material for the production of an Asiatic volume was practically complete in India, and that it should be possible without very much difficulty to arrange that material for publication. The African volume had appeared some time before the war. The Geological Survey of the United States had issued its own Lexicon of Stratigraphic Terms in so far as North America was concerned. As regards Europe, he had no information, but he suggested that the Commission on the Lexicon of Stratigraphy be continued in being with the object of trying to produce volumes for each of the other Continents for which so far there was no publication.

Professor V. V. Belousov (U.S.S.R.) wished to support the continuation of the Commission. A great deal of work in connection with the Lexicon had been done in the Soviet Union, especially by A. N. Krishtofovitch, whom the Soviet delegation wished to propose as a member of the Commission. Since Academician Krishtofovitch was not present at the Congress, he would ask Professor E. O. Pogrebitsky to act on the Commission at the present meeting.

## COMMISSIONS

Dr. Haughton (South Africa) suggested that members of the Commission and others who were interested should attend a meeting on Saturday at 2-30 p.m.

Professor J. Cuvillier (France) said that as Professor Jacob, who was a member of the Commission, was not present at the Congress, the French delegation proposed that Professor Pruvost should replace him.

Professor G. M. Cardoso (Spain) reported that Dr. Ricardo Madariaga had died since the last Congress, and proposed himself as a member of the Commission.

*These proposals were agreed.*

## FOSSIL MAN

The Chairman said that at the Seventeenth Session in Moscow there had been carried a motion that the Commission on Fossil Man be turned over to the International Paleontological Union, but the late Professor Madsen, who had been President of the Commission but had not been present at Moscow, had subsequently requested that the transfer should not be effected until there had been an opportunity for members of the National Sub-Commissions to discuss the desirability of that transfer.

During the last year Dr. K. S. Sandford, the Secretary of the British Sub-Commission of that Commission, had circularized as far as possible all members of the Commission asking for their opinion, but the replies had been scanty and inconclusive. Professor Madsen, in a letter to the General Secretary in 1938, had suggested that Dr. Sandford should succeed him as President of the Commission.

The Chairman suggested the following resolution: "That, subject to the agreement of the International Paleontological Union, the Commission on Fossil Man be formally transferred to that Union in accordance with the resolution of the Seventeenth Session, and that a recommendation be transmitted to the Union that the officers of the Union, Dr. Sandford and any members of the Commission present at this Congress, or their delegates, should jointly consider whether it is desirable and practicable to revive the Commission."

*The resolution was agreed.*

## CRUST OF THE EARTH

The Chairman called upon Professor Fourmarier to fix a time of meeting for members of the Commission who were present at the Congress.

Professor P. F. J. Fourmarier (Belgium) said that he would like the Commission to continue its work. He would not like to fix a definite day and time of meeting since he had not yet had an opportunity of meeting all the members who were present at the Congress. He suggested that members of the Commission should first see him informally.

Professor V. V. Belousov (U.S.S.R.) said that he would be interested to join the Commission.

Professor André Demay (France) proposed that Professor Wegmann be a member of the Commission.

*These proposals were agreed.*

## GEOPHYSICS AND GEOTHERMICS

The Chairman said that the functions of the Commission were defined in the Report of the Seventeenth Session. They were generally speaking the promotion of geophysical work for the purpose of throwing light on specific geological problems. The President was Professor P. M. Nikiforov, of the U.S.S.R., and he asked the Soviet delegation and any other members of the Commission now present whether they wished the Commission to be revived.

Professor V. V. Belousov (U.S.S.R.) reported the death of Professor Nikiforov since the last Congress. The Soviet delegation felt that the Commission should continue its work, and proposed as members Professor G. P. Gorshkov, of the Geophysical Institute of the Academy of Sciences of the U.S.S.R., in place of the late A. D. Archangelsky, and Professor V. F. Bonchkovsky, of the Geophysical Institute of the Academy of Sciences of the U.S.S.R., in place of the late P. N. Nikiforov.

## PART I: GENERAL PROCEEDINGS

The Chairman said that there appeared to be very few members of the Commission present at the Congress, but one member was Sir Edward Bailey. He suggested that Sir Edward be asked to get in touch with such members of the original Commission as were present and to arrange a meeting.

*This was agreed.*

### GEOLOGICAL MAP OF EUROPE

The Chairman said that it was difficult to see how progress could be stimulated at the present time in the preparation of a geological map of Europe, and he thought the best plan would be to defer the revival of the Commission until the next Session, but in the meantime to instruct the Bureau to promote and support the continuation of the work of preparation and publication of maps before that Session, if conditions permitted.

Professor A. Renier (Belgium) said it would be a great pity to allow the Commission to die. It was the oldest of the Commissions of the Congress, since it had been in existence since before 1900. Work had been progressing on the second edition of the Geological Map of Europe, which would have been published but for the recent war. He felt that the German geologists who were present at the Congress could perhaps ensure the continuation of the work. He suggested that the General Secretary might put up a notice indicating a time for a meeting at which those interested in the matter could discuss the possibilities of continuing the work.

Professor J. Cuvillier (France) reported the death of M. de Launay, the French member of the Commission, and proposed that Monsieur E. Raguin, the head of the Service de la Carte géologique de France, be appointed to the Commission.

Dr. P. A. Geijer (Sweden) said that the Swedish member of the Commission was also dead. He suggested that the Swedish representative should be the director of the Geological Survey, which happened for the time being to be himself, although he would be retiring before the next Congress took place. It was important that the work should be collected by the institutions, which continued, whereas men passed away.

The Chairman suggested that the meeting should be fixed for 4-30 p.m. on Saturday, August 28th.

*This was agreed.*

The Chairman reported that the Soviet delegation wished to replace the late A. D. Archangelsky by Academician D. V. Nalivkin, both in the Commission on the Geological Map of Europe and that on the Geological Map of the World; and to replace the late I. M. Goubkin by Academician I. I. Gorsky.

### GEOLOGICAL MAP OF THE WORLD

Monsieur F. Blondel (France) said that as in the case of the Geological Map of Europe, the work on the Geological Map of the World had been done in Berlin, and it had not been possible even to make a report at the Seventeenth Congress in Moscow. He would very much like to have a meeting of the remaining members of the Commission, in order to reorganize it, since many of the members had died. He proposed a meeting on Monday, August 30th, at 2-30 p.m.

*This was agreed.*

### DISTRIBUTION OF THE GONDWANA (KARROO) SYSTEM

The Chairman reported that the President of the Commission was dead, but that the Secretary, Dr. Haughton, had prepared a report for submission to the Commission. He suggested that Dr. Haughton be invited to fix a time for a meeting of the Commission and that the meeting then appoint a President and continue its work.

Dr. S. H. Haughton (South Africa) said that he would like to meet informally, possibly immediately after the present meeting, such members of the Commission as were present and try to arrange a time which was mutually suitable. He would then ask the General Secretary to put a notice on the board.

*This was agreed.*



## COMMISSIONS

### INTERNATIONAL GEOLOGICAL MAP OF AFRICA

The Chairman said that this Commission and its Sub-Commission were very thriving bodies. He would like them to continue their work and to submit a report to the Council.

Monsieur F. Blondel (France) replied that a report on the work of the Commission would be submitted when its work at the Congress was completed. The Commission had already had a meeting to elect members to replace those who were not present. The President was M. de Margerie, of France, who had been elected at the first meeting; and fortunately the Vice-Presidents were alive and would continue in office. The Commission was working normally and regularly.

### AUTHORS' ABSTRACTS

The Chairman said that the President of the Commission was unable to be present, but he had written suggesting that Dr. Haughton or Professor Gordon take the Chair at meetings of the Commission during the present Session, and that the Commission be expanded to include one representative of each country taking part in the Session.

Dr. S. H. Haughton (South Africa) said that he would prefer Professor W. T. Gordon (Great Britain) to act as Chairman.

The Chairman asked Dr. Haughton to get in touch with Professor Gordon and request him to undertake the task.

Professor G. M. Cardoso (Spain) proposed that, in the absence of the Spanish member of the Commission, Professor J. Royo y Gomez, his place should be taken by Professor E. Alastrué, of the Universidad de Sevilla.

Dr. Ardito Desio (Italy) reported the death of Professor G. Stefanini, the Italian member of the Commission. The Italian delegation had not yet had an opportunity of deciding who should replace Professor Stefanini, but would inform the General Secretary as soon as a member had been decided upon.

The Chairman invited anyone interested in the work of the Commission to attend the meeting.

### PETROLOGY, MINERALOGY AND GEOCHEMISTRY

The Chairman said that at the Seventeenth Session it had been suggested that a permanent Section of the Congress having this title should be established, but that instead it had eventually been agreed to establish the Commission on Petrology, Mineralogy and Geochemistry. Only the President and the four Vice-Presidents had been elected at the Seventeenth Session, and all of them were now dead.

The main intention of the proposal had been to ensure that each Session of the Congress should provide adequate opportunities for meetings and discussions between specialists on these subjects. Members would see that that intention had been carried out by the General Organizing Committee of the Eighteenth Session, and similar arrangements would be made at future Sessions. He suggested that for the time being the Commission should not be revived. He would be glad to hear any expression of opinion on this matter.

The field of study covered by the Commission seemed to be adequately taken care of by Sections A and B of the present Session. If there were any narrow field in petrology or mineralogy that might be explored, this would be a proper subject for the Commission, but the terms of reference seemed to be so wide that he could hardly see what function the Commission could perform. To have a Commission such as this one appeared to him almost like saying, "Let us have a Commission on Geology." The Commission was so wide that it covered half the work of the Congress. Did members agree that the Commission be allowed to die a natural death?

*The Chairman's proposal was agreed.*

### DETERMINATION OF GEOLOGICAL AGE BY RADIOLOGICAL METHODS

The Chairman pointed out that only the President and the Vice-President of this Commission had been elected at the Seventeenth Session. Geological Surveys in countries interested in promoting

## PART I: GENERAL PROCEEDINGS

international co-operation on this subject had been asked to nominate representatives, but only two had done so—Uganda and the Gold Coast. The Vice-President was dead, and the President, Dr. Lane, had deputed Dr. J. P. Marble to act for him. Dr. Marble suggested that the Commission, which had never yet functioned, should not be resuscitated.

Dr. J. P. Marble (U.S.A.) said that Professor Lane had died suddenly in April, after he had written to the General Secretary of the Congress. In view of the fact that the Commission had never started to function and in view also of the present international restrictions with regard to information on subjects dealing with radiological activity, it seemed inadvisable at present to continue the work of the Commission. On behalf of workers in this field, he would like at the next Session of the Congress to raise the question of the reconstitution of the Commission, assuming—as they all hoped—that it would be politically possible to continue this valuable work.

The Chairman asked whether there was any objection to the proposal that the Commission be allowed to lapse until the next Session of the Congress.

*The proposal was agreed.*

The Chairman, in closing the meeting, asked the Commissions to hand their reports to Professor Hawkes by the evening of August 30th. At that time they should be prepared to give a brief report to the Council, at its meeting on August 30th. The full reports would be published.

*The meeting ended.*

### Report of the Commission for the Spendiarov Prize

The Commission has been reconstituted as follows:—

E. B. Bailey (Great Britain), *President*.

V. V. Belousov (U.S.S.R.).

E. Blackwelder (U.S.A.).

P. Pruvost (France).

The Commission recommends the award of the Spendiarov Prize for the Eighteenth Session to Professor L. R. Wager, of Durham University, in recognition of his researches in Greenland and in the Himalayas.

E. B. BAILEY, *President*.

Note.—The President of the Commission, E. B. Bailey, subsequently recommended to the Bureau that the membership of the Commission at the Nineteenth Session shall be as follows:—

P. Pruvost (France), *President*.

E. B. Bailey (Great Britain).

V. V. Belousov (U.S.S.R.).

E. Blackwelder (U.S.A.).

D. N. Wadia (India).

Following this recommendation, and subject to confirmation by the Council of the Nineteenth Session, the names above are quoted in the List of Members of Commissions given earlier in this volume.

### Minutes of Meetings of the Commission on the Lexicon of Stratigraphy

FIRST MEETING: Saturday, 28th August, 1948

Present: S. H. Haughton (Union of South Africa), *Secretary*.

L. L. Fermor (India).

G. M. Cardoso (Spain).

T. K. Huang (China).

A. Desio (Italy).

In the absence of the President, Dr. Haughton took the Chair.

The Commission considered membership and recommended that, in addition to the changes

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made at the General Meeting of Commissions, the names of Dr. T. H. Yin, of the Geological Survey of China, and Dr. H. G. Raggatt, be added to the membership as representatives of China and Australia, respectively.

The Commission also decided to request Sir Edward Bailey to accept the Presidency.

Dr. Haughton suggested that it would be desirable that the President and Secretary should be resident in the same country, and he therefore requested that he be relieved of duties as Secretary of the Commission and that he should consult with Sir Edward Bailey regarding the nomination of a successor.

Professor G. M. Cardoso stated that he had been nominated at the General Meeting of Commissions to replace the late Mr. Madariaga but that as he was a member of the Commission on the Earth's Crust, the Spanish delegation proposed that he be replaced on the Commission of the Lexicon of Stratigraphy by Professor Clemente Saenz. The Commission approved.

Dr. Desio stated that he was representing Dr. Dal Piaz who, although a member of the Commission, was not present at the Congress.

The Commission suggested that the Secretary of the Commission should be resident in Great Britain provided that Sir Edward Bailey is prepared to accept the position of President, and that a further meeting of the Commission will be held to agree to a nomination made by Sir Edward Bailey.

Sir Lewis Fermor explained the position with regard to Asia and considered that the project was sufficiently advanced for it to be continued and brought to completion. It was suggested that the Director of the Geological Survey of India be approached in the matter and informed that, so far as China is concerned, much material is now available as the Chinese Geological Survey has been preparing its portion of the Lexicon which is in England.

The Commission decided to meet again on Monday, August 30th, at 11-30 a.m.

### SECOND MEETING: Monday, 30th August, 1948

Present: S. H. Haughton (Union of South Africa).

L. L. Fermor (India).

T. K. Huang (China).

P. Pruvost (France).

1. The Minutes of the first meeting were accepted.

2. Dr. Haughton stated that Sir Edward Bailey was prepared to accept the Presidency of the Commission provided that a Secretary resident in Great Britain was appointed. Dr. Stubblefield had suggested, in conversation, that Mr. A. J. Butler should be requested to become Secretary.

The members present therefore recommended that the membership of the re-constituted Commission should be:—

*President* E. B. Bailey (Great Britain)

*Secretary* A. J. Butler (Great Britain)

<i>Members</i>	Australia	...	...	...	H. G. Raggatt
	Belgium	...	...	...	A. Renier
	China	...	...	...	T. H. Yin
	France	...	...	...	P. Pruvost
	Germany	...	...	...	H. Schindewolf, H. Cloos
	India	...	...	...	L. L. Fermor
	Italy	...	...	...	G. Dal Piaz
	Mexico	...	...	...	H. Mullerried
	South Africa	...	...	...	S. H. Haughton
	South America	...	...	...	H. Harrington
	Spain	...	...	...	C. Saenz
	U.S.A.	...	...	...	J. B. Reeside
	U.S.S.R.	...	...	...	A. N. Kristofovich



The Commission suggested that other names could be added by the Bureau if it were considered desirable.

3. The Commission recorded its opinion that the Secretary should arrange for the nomination of an Editor for each continent.

4. The Commission considered that an attempt should be made to issue volumes for each continent conformable with the volume on Africa.

## Report of Commission de la Croûte terrestre

La commission n'a pu tenir qu'une seule séance. Elle a pris les décisions suivantes:—

1. Il sera demandé au Conseil d'agréer la nomination comme membres de la Commission, de:—

G. M. Cardoso (Espagne)

T. K. Huang (Chine)

A. Noe-Nygaard (Danemark)

en plus de V. V. Belousov et E. Wegmann admis à la séance du Conseil du 26 août.

2. M. Wegmann a été désigné comme Secrétaire.

3. Quant à son activité jusqu'au prochain congrès, la Commission a adopté les résolutions suivantes:—

(a) Conformément aux décisions prises à Moscou en 1937, la Commission s'occupe de mettre au point un lexique tectonique en prenant comme base l'ouvrage de Heim et de Margerie.

Un tel lexique a été préparé par les géologues russes. Le texte sera soumis aux membres de la Commission.

(b) Il sera envisagé un projet d'unification des signes employés sur les cartes pour la figuration des particularités tectoniques.

(c) D'autres sujets seront mis à l'étude en ce qui concerne spécialement les questions de nomenclature: géosynclinaux, métamorphisme, migmatites, etc. Les membres de la Commission sont invités à se mettre en rapport avec le président à cet effet.

*Le Président, P. FOURMARIER.*

## Report of the Commission for the International Geological Map of Europe

According to the motion adopted on August 25th in the Assembly held to consider the future work of the Commissions, a meeting about the Geological Map of Europe was called on Saturday, August 28th, at 4-30 p.m. Six members attended, the Chair being occupied by A. Renier, until now the representative of Belgium on the Commission.

Regarding the state of the Map, it was noted that the second edition will not be extended southwards to include a part of Africa, which has its own map of which three sheets are published.

Of the second edition of the Geological Map of Europe, eight sheets are published: A IV, B IV London, C IV Berlin, D IV Warschau, A V and B V Marseille, C V Alpen, D V Karpathen. They are to be obtained at the Hessisches Landesamt für Bodenforschung, Wiesbaden (Parkstr. 38).

In September, 1938, the sheets A VI Lisbon, B VI Madrid and C VI Rome were ready for printing. Regarding D VI some difficulties remained.

In January, 1939, a limited meeting was held in Stockholm to consider the sheets C III and D III.

As regards the future composition of the Commission, the following list was unanimously adopted, it being recognized that the Heads of the national Geological Surveys are specially qualified to represent

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their own countries. These Heads shall have power to nominate their representatives for the Commission meetings.

<i>President</i>	...	W. Kegel (Germany)
<i>Vice-Presidents</i>		M. Gortani (Italy)
		Per A. Geijer (Sweden)
<i>Secretary</i>	...	H. R. von Gaertner (Germany)
<i>Members</i>	...	Austria ... G. Götzinger
		Belgium ... A. Grosjean
		Czechoslovakia ... R. Kettner
		Denmark ... H. Ödum
		France... ... E. Raguin
		Great Britain... ... W. F. P. McLintock
		Greece... ... —
		Hungary ... —
		Italy ... M. Gortani
		Norway ... C. Bugge
		Poland... ... J. Czarnowski
		Portugal ... Antonio Viana
		Rumania ... G. Macovei
		Spain ... J. G. Siñeriz
		Sweden ... Per Geijer
		Switzerland ... R. Buxtorf
		U.S.S.R. ... I. I. Gorsky, D. V. Nalivkin

ARMAND RENIER, *Chairman.*

## NOTE ON THE WORK CARRIED OUT ON THE INTERNATIONAL GEOLOGICAL MAP OF EUROPE, SCALE 1 : 1,500,000

The following sheets of the second edition of the Map are already printed: A IV, B IV London, C IV Berlin, D IV Warsaw, A V and B V Marseilles, C V The Alps, D V The Carpathians.

The drafts of Sheets A VI Lisbon, B VI Madrid, and C VI Rome have been prepared and were declared completed at the last session of the Map Commission in September, 1938. The sheets comprise the countries of the Western Mediterranean. The main difficulty encountered in the drawing up of these sheets was the representation of the territory of Morocco and Tunisia. This was overcome owing to the good collaboration with the local State Institutes, so that a satisfactory representation was arrived at. The printing of the sheets has not begun yet, as the material was shut away owing to the war.

Of Sheet D VI Athens, about one half is ready in draft. The geological fair copy of this Sheet presents great difficulties, because for the Greek part only Phillipson's maps are available, which are out of date and have to be corrected. The only thing that can be done is to bring this Sheet up to date with the help of the existing extensive literature, and especially to make the changes in interpretation implied by the conception of thrust structure made necessary by Renz's works. This work has been begun, and has been finished for Morea. It was shown that the change in interpretation could be carried out satisfactorily. Unfortunately it was not possible to discuss questions of detail at the last Map Conference in 1938, because the Greek representative was prevented from attending. Further difficulties are presented by the newly-acquired knowledge of the age of the Ophiolite series in Yugoslavia, which may have consequences that cannot as yet be properly seen, for the whole of the southern Balkans. But here too a way has been found to carry out the map representation satisfactorily. Thus it can be said in general that the completion of Sheet D VI is in the main a question of time and one of finding suitable geologists, although collaborators for this are now again available after the war.

Topographic corrections are also required on a large scale for Sheet VI. These corrections have been started upon.

In accordance with the decision of the Map Commission in September, 1938, preparations for the representation of the sheets of Series III have been taken in hand. At a special meeting in January, 1939, in Stockholm, agreement was reached concerning the co-ordination of the Scandinavian Crystalline and its representation, so that there is a basis to work from. Data for the completion of the topography have been received from most countries (cf. enclosure).

For Sheet C III, the final drawing of the Norwegian part has been completed on the basis of a draft made by Norges Geologisk Undersøkelse. For the Swedish part, preparation of the geological material is concluded, but final drawing has not yet been begun. The same applies to the Swedish part of Sheet D III. For the main part only preparatory work has been done so far. The difficulties in the representation of these sheets lie particularly in the separation of the Pleistocene from the older formations. The very close dove-tailing of this formation in the Scandinavian area is well known and makes it really only possible to produce either Quaternary or older maps of the mountains. In order to make complete map representation possible, however, it has been decided to separate larger areas with Pleistocene only. Such areas are deemed to be mainly fluvio-glacial and valley deposits, while the generally existing moraine covering is to be ignored. Data for this separation have been furnished for the Swedish part, and can be taken from existing maps for the Finnish parts. The main terminal moraine lines are to be represented by overprinting of red dots right across the older mountains, as in the first edition.

Sheet D III contains, besides the Finnish part, larger areas of Latvia, Estonia, and Lithuania. Here the question of the drawing of frontiers between the Pleistocene and the older layers is even more difficult. It seems likely that here, as in the territories lying to the south of this area and where it seems certain that no differentiated map on an 1:1,500,000 scale can be produced, a representation of the Pleistocene will be preferred, as was also done for Sheet D IV. The big difficulty arising here is, however, that there are no data for the rather detailed structure of the Diluvium in this area, and they will hardly be forthcoming. The material exists for the basis, which can be made visible in a similar way as in the Danish area on Sheet C IV.

Apart from this, a considerable amount of preparatory work (fair copy of part of the Sheet on the basis of drafts of the Geolog. Comm. of Moscow) for Sheet E V has been in existence since 1924.

W. KEGEL, *President*.

## Report of Commission de la Carte géologique du Monde

La Commission s'est réunie le lundi 30 août à 14 hrs. 30; étaient présents:—

F. Blondel (France), *Vice-Président*.

*Membres:* G. Castany (Tunisie)

L. L. Fermor (Grande Bretagne)

P. F. J. Fourmarier (Belgique)

M. Gortani (Italie)

S. H. Haughton (Afrique du Sud)

T. K. Huang (Chine)

H. R. Junner (Grande Bretagne)

W. Kegel (Allemagne)

F. R. Vilaplana (Espagne)

Le Vice-Président explique que la Commission s'est réunie pour la dernière fois à Berlin les 28 et 29 septembre, 1938.

Après un échange de vues, les membres présents recommandent au Conseil et l'Assemblée les propositions suivantes qui tiennent compte des grandes difficultés actuelles:



1. Conformément au vœu exprimé par la Commission en septembre, 1938, il est proposé que les membres de la Commission ne soient plus en principe, désignés nominativement. La Commission comprendrait donc les directeurs des Services géologiques des différents pays du monde. Cependant la Commission s'adjoindrait certaines personnalités qu'elle choisirait elle-même en raison de leur compétence spéciale.

2. Il ne semble pas souhaitable de nommer actuellement un nouveau Président.

3. Le Vice-Président en exercice aura la charge de réunir la Commission dès que les circonstances paraîtront plus favorables. Pour cette première réunion, le Vice-Président invitera lui-même, après consultations convenables, les personnalités autres que les directeurs des Services géologiques.

4. Lors de cette prochaine réunion, la Commission examinera les possibilités et les moyens de reprendre activement les travaux antérieurs.

F. BLONDEL, *Vice-Président*.

#### NOTE ON THE WORK CARRIED OUT ON THE INTERNATIONAL GEOLOGICAL MAP OF THE WORLD, SCALE 1 : 5,000,000

Of this Map, Sheets 62, 63, 68 and 69 (South Africa) have been printed. In accordance with the wishes of the Map Commission, further work on the African sheets has been suspended for the time being, in order to await the printing of the International Geological Map of Africa on the same scale, as decided upon by the International Congress in 1923.

In lieu of further work on Africa, the North American Continent has been started with. It was found convenient to use for this purpose the geological survey map of North Africa which had been prepared for the International Geological Congress. The topography of Sheets 11, 12 and 13 was done first. The topographical fair copy of these has been concluded and was submitted to the Map Commission in 1938. The geological fair copies of Sheets 11 and 13 are concluded in the main. On Sheet 11, however, the structure of the volcanic rocks in accordance with the agreed colour interpretation has yet to be drawn in. The colour interpretation envisages a very detailed subdivisioning of the volcanic rocks according to their chemical composition. The data for this are very difficult to obtain, as the North American map only differentiates the ages of the volcanic rocks, while volcanic rocks of one age have very different chemical compositions. It has also not yet been decided how far the envisaged differentiation can really be carried out satisfactorily. It must, however, be pointed out that in other parts of the world the American method of classification will lead to very great difficulties, because for some series of volcanic rocks, where the chemical details are known in sufficient detail, no age classification has yet been done.

The Canadian part of Sheet 11 has not been drawn up yet, but it should be possible to sketch this on the basis of the existing data.

The fair copy of Sheet 12 has been started upon. Here, however, the difficulties are much greater than with the other sheets mentioned so far. Apart from the difficulty in the classification of volcanic rocks encountered with Sheet 11, there is a further difficulty, because the survey map of the U.S.A. shows the mineral series in the Appalachian Mountains only summarily, while the colour interpretation of the Map of the World calls for a detailed classification. It is difficult to procure the material for the carrying out of this detailed classification in Europe. Most of all, it is difficult to judge how far the material is really the most recent in a particular field. But a difficulty of principle which can apparently only be overcome with the help of a great amount of topographical material, is the question of the differentiation of the Pleistocene from the older formations. Of course, the northern part of Sheet 12 is largely covered with Pleistocene layers of varying thickness, which in accordance with the principles of the Map have to be represented. But there hardly is a possibility of differentiating satisfactorily between the areas completely covered with Pleistocene and those only loosely or thinly covered. This difficulty has made it appear advisable to hold over the completion of the fair copy until it can be discussed at an International Congress.

A further difficulty is presented by the structure of the Pre-Cambrian basement rocks, especially

the connection of the Canadian with the U.S.A. part. The material available for this is insufficient in many points, but it seems that it can hardly be improved upon. Ways of representation were found shortly before the war, mainly due to the assistance of the Canadian Survey. Here, too, a discussion of these points at the International Congress, particularly with the Canadian and U.S.A. specialists, would be desirable.

There is further in existence a geological fair copy of Sheet 45, dating from 1914. The representation of this Sheet is still satisfactory in many points even now. This shows that a map on the survey scale of 1: 5,000,000 ages rather slowly if great care is taken with the first draft.

The grid has been drawn for all sheets. For Sheets 7, 44 and 45 a topographical draft, finished in the essentials, is in existence, and for Sheet 56 a master copy. The topographical drawings of Sheets 5, 46, 49, 50, 51, 55, 57 and 75 have been begun. It would be desirable to press forward more quickly with the topographical work. For this purpose, extensive assistance by the supply of topographical basic material is desirable. Very likely such material is now again available for large parts of the world, but has not yet been made accessible to the scientists engaged on the drawing up of the International Map. Perhaps the Map Commission could, through the International Geological Congress, make this material available for the production of the Map of the World.

W. KEGEL.

## Proceedings of the Commission on the Distribution of the Gondwana (Karoo) System

REPORT OF A MEETING OF THE COMMISSION, SATURDAY, AUGUST 28th, 1948

*Present:* Dr. S. H. Haughton (South Africa),  
Monsieur A. Jamotte (Belgian Congo).

The Commission on the Distribution of the Gondwana System was called for 4 p.m. on August 28th, but only Monsieur A. Jamotte, representing the Belgian Congo, and Dr. S. H. Haughton attended. The latter presented a report, and it was agreed to present this report to the Council with a recommendation that it be printed in the proceedings of the Congress.

The two members present noted that all of the members individually named at the Seventeenth Congress were dead and that the Commission was without a President.

It was decided to leave the matter of the re-election of a Commission in the hands of the Bureau.

S. H. HAUGHTON, *Secretary*.

## REPORT OF THE SECRETARY OF THE COMMISSION

At the last meeting of the Commission, held in Moscow on July 26th, 1937, it was recommended that the Commission "be asked to prepare for the next session a summary of the evidence bearing on climatic conditions in the various parts of the Gondwana land during the Carboniferous, Permian and Triassic periods."

Although members of the Commission were circularized at the end of 1937 and beginning of 1938 to provide information regarding evidence from the territory which each represented, preparatory to the compilation of the requested summary for presentation to the Congress planned for 1940, the onset and prosecution of World War II prevented most members from attending to this business of the Commission. Some correspondence has taken place during recent months and certain information has been collected; but this, it seems, is insufficient to enable the Commission to prepare a full summary of the evidence.

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A report has, however, been prepared to include the information at present attainable; and this report is given hereunder.

S. H. HAUGHTON, *Secretary*.

### 1. WORK PRIOR TO THE SEVENTEENTH CONGRESS

In the *Report of the Seventeenth Session, International Geological Congress*, Vol. 6, 1940, the following papers dealt with climatic conditions during the deposition of beds of the Gondwana system.

- |                  |   |
|------------------|---|
| 1. C. S. Fox     | The Climates of Gondwanaland during the Gondwana era in the Indian region.        |
| 2. D. N. Wadia   | Note on the Palæogeography and Climate of Kashmir during the Permo-Carboniferous. |
| 3. A. L. du Toit | Climatic variations over southern Africa during the later Palæozoic.              |
| 4. N. Boutakoff  | The Dwyka glaciation and the Ecça epiglacial beds of the Congo basin.             |
| 5. B. Sahni      | Speculations on the Climates of the Lower Gondwanas of India.                     |

A very brief summary of these papers is all that is necessary here.

*India*.—Fox included in the Gondwana system all the freshwater beds included between the base of the Talchir boulder-bed to the top of the Umia beds, a somewhat broken succession extending from the Moscovian-Uralian of the European time-scale to the Lower or even Middle Cretaceous. This succession is more extensive than that of the Karroo system in southern Africa. He subdivided the succession into Lower Gondwana, consisting of Talchir, Damudas—with the lower and upper coal measures separated by the Barren measures—and Panchet (terminating in the Parsora beds—L. Trias) and Upper Gondwana (consisting of Mahadeva, Rajmahal, and Jabalpur), the two being separated by an unconformity. Sahni included the Parsora in the Lower Gondwana and stated that its flora is “certainly not younger than the Trias and possibly as old as the Upper Permian.”

Fox stated that in Talchir times the entire Indian peninsular area was a land surface of high elevation, ice-bound and barren, with a sea over parts of what are now the Punjab and Kashmir. But the climate rapidly ameliorated after Talchir times and he considered it logical to conclude that, in Damuda times, the climate was warm to tropical and humid rather than temperate. He drew attention to the lack of faunal remains in the Damuda sediments, a lack which is also apparent in the Ecça coal-measures of the Transvaal and Natal. He considered that the Damuda sediments were deposited in wide valleys, resembling vast lake-like depressions such as those of the Nyanzas in Central Africa.

The Panchet (which Fox placed in the Triassic) has a vertebrate fauna which can be correlated with that of the Beaufort beds of South Africa. The beds contain grains of undecomposed feldspar; but these are considered to be the product of arid hot climatic causes. It is to the aridity that Fox attributed the “disappearance of the *Glossopteris* flora in the middle of the Triassic period.” In the succeeding Jurassic there was a period of marine transgression and a return to a warm, humid climate.

Fox stated that the advance and retreat of the sea had clearly affected the climate of Gondwanaland by increasing or decreasing its humidity.

Wadia showed that in Kashmir the Talchir commences with a pyroclastic agglomerate many thousands of feet thick and that no glacial deposits are present. Volcanic activity continued into the Trias; but *Gangamopteris*, *Glossopteris* and *Cordaites* are preserved as species allied to those of the Karharbari and Lower Damudas of peninsular India. He considered that the Kashmir region must be regarded as forming the northernmost frontier of Gondwanaland and that it served as a land-bridge between Gondwanaland and Angaraland, enabling links to be established between the floras of these two continents.

*Africa*.—Du Toit summarized the climatic conditions over southern Africa as, in general: sub-temperate for the Devonian and earlier Carboniferous, glacial for the later Carboniferous, cold wet temperate for the earlier Permian, temperate for the later Permian and warm to arid for the Triassic.



He considered the Dwyka tillite, which reaches its maximum development in the south, as being the product of the southern side of a vast ice cap; but the thickening of the succeeding Ecce sediments from north to south was considered by him to point to the south as the quarter from which the bulk of the material comprising the "southern Ecce" was derived. As, however, there is no evidence of orogenic movement in the south during or just after Dwyka times, it is suggested that du Toit should have visualized the thick southern Dwyka tillite as having been derived from a southern continent and deposited on its northern flank.

Du Toit drew attention to the different facies of the beds of the Ecce (post-Dwyka) series in the Union of South Africa. In the south, along the northern edge of the Cape folds, occurs his "green facies" with thickness of approximately 10,000 feet in places. Both true conglomerates and coals are absent; the rock types show rapid lateral variation; while the frequent presence of ripple-marks, mud-cracks, and mud-pellet conglomerates give evidence of deposition in shallow waters in a basin whose rate of sinking was compensated by the rate of deposition. Cores from some deep boreholes sunk in the western portion of this southern belt have been studied by H. J. Nel of the Union Geological Survey. His results are summarized in a later section of this report.

The "Coal Measure" facies of the Ecce, spread over Northern Natal, the Transvaal, and the Orange Free State of the Union and extending into Southern and Northern Rhodesia, is characterized by light-coloured sandstone, grits, arkoses and conglomeratic sandstone intercalated with finer-grained argillaceous and arenaceous rocks with coal seams. These were considered by du Toit to have been laid down in a cold wet temperate zone, the climatic conditions having caused bleaching and rotting of the underlying tillite. He drew attention, however, to the presence of much fresh angular feldspar in the coarser clastics of this facies of the Ecce.

Westwards, over the south-western Kalahari and parts of South-West Africa, the Ecce displays a "red" facies and consists of mudstones, sandstones and calcareous sandstones. Du Toit considered that these were laid down at a low altitude on wide flats that were periodically flooded and strongly desiccated under a hot dry climate.

The same author described the Lower Beaufort beds (Upper Permian) of most of the Union, Rhodesia, Nyasaland, Tanganyika and Madagascar as probably "accumulated in interior basins of considerable size under a generally warm climate with intermittent rainfall, the few plants signifying a scanty vegetal covering." He went on to say that the Triassic "saw the active extension of the red beds type of sedimentation over a great region." Lithologically, from south to north, beds of the same age are progressively redder; but in the southern area the deposition of "red beds" was interrupted by that of the coarse deltaic Molteno sediments (Upper Triassic) which, to du Toit, argue for a pluvial interlude.

*Congo.*—Boutakoff's paper dealt with the Dwyka glaciation and the Ecce epiglacial beds of the Congo basin. He concluded that the Karroo beds of the Congo were accumulated "in a succession of small lacustrine cuvettes on the back of a high mountainous plateau and, in part, on the land surface of that plateau." He pictured a first glacial stage, in which ice fluctuations were "of sufficient magnitude to influence even the head areas of the glacial valleys." This was followed by a total melting of the ice and the deposition of sandstones. Then came a "second and much less important glaciation" during which varves containing erratics were deposited. Finally came a breaking-up of the glaciers and floating icebergs, progressive flooding of all the valleys and the deposition of black shales during the Ecce. Boutakoff thus considered the Congo glacial sediments to be "those of highlands, extending outside the main area of the Dwyka glaciation, and occupied by glaciers mostly on account of their altitude."

## 2. WORK FROM 1937 TO 1947

*Argentine.*—From 1940 onwards, J. Frenguelli published a considerable number of papers, in *Notas del Museo de la Plata* and in *Revista del Museo de la Plata*, dealing mainly with the flora of the Upper Gondwana in the Argentine Republic. In 1944, he discussed briefly the correlation of the

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“ Rhaetic ” in the western Argentine, formerly known as the Cacheuta series. He gave the following correlation.

Cacheuta-Potrerrillos area	Ischigualasto-Ischichuca area
4. Estratos del Rio Blanco.	Estratos de Gualo.
3. Estratos de Cacheuta.	Estratos de Ischigualasto.
2. Estratos de Potrerillos.	Estratos de Los Rastros.
1. Estratos del Cerro de las Cabras.	Estratos de Ischichuca.

The Cerro de las Cabras beds rest unconformably on older rocks and include coarse conglomerates interbedded with sandstones, tuffs and sandy tuffs of a grey colour or in part polychrome, sometimes brightly coloured. The conglomerates are considered to be of the nature of fanglomerates. In the upper part of the Ischichuca beds are frequent intercalations of carbonaceous shales.

The Potrerillos beds are principally tuffs, sometimes arenaceous, sometimes argillaceous or bentonitic, in part intercalated with sandstones or conglomerates. The conglomerates are mainly fluvatile in origin. The tuffs are essentially of lacustrine origin and predominantly composed of a pelitic fraction formed principally of vitreous acid volcanic material. The Los Rastros beds form a thick succession of argillaceous shales, partly arenaceous, of a greyish-green colour, with intercalations of bands of greyish sandstone and shaly sandstone and some carbonaceous shales. At the top is a zone of conglomerate. At the base occurs *Rigalites ischigualastianus* v. Huene.

The Cacheuta beds contain abundant *Estheria forbesi* Jones as well as a great quantity of fossil plants. Predominantly they consist of tuffy argillaceous shales of fine and homogeneous grain, of a yellowish colour except at horizons which have been impregnated to a greater or less extent by bitumen. In the lower transition beds, medium to fine grained sandstones are sometimes intercalated with the pelitic tuffs. The Ischigualasto beds are formed of argillaceous or arenaceous greyish tuffs alternating with lenticular masses of grey sandstone which is cross-bedded. They have yielded therapsid reptiles.

The Rio Blanco and Gualo beds are mainly reddish sandstones.

Frenguelli considered that both areas show a change of climatic conditions from humid and cool to hot and arid, and that as a result of this change lacustrine conditions were replaced by desert conditions.

He further stated that the first three subdivisions are to be considered wholly as Triassic; the youngest of them is Upper Triassic (Keuper) while the earliest may be in part Lower Triassic. The term Rhaetic should not be applied to the fossiliferous sediments in these two areas.

In the series of papers entitled “ Contribuciones al Conocimiento de la Flora del Gondwana Superior en la Argentina,” Frenguelli has dealt in considerable detail with the flora and has correlated the various genera and species with the stratigraphy. A number of new genera and species are described and figured. The author discussed the age of the plant-bearing continental beds in the Argentine usually known as “ Rhaetic ” and concluded that the sequence of more than 1,500 metres of beds comprises a series from the Keuper to the lower part of the Hettangian inclusive. He also considered the term “ Thinnfeldia flora ” to be too inexact to be used as an efficient instrument of stratigraphic comparison and of chronologic correlation.

In 1945, Frenguelli recorded continental mollusca from the Upper Gondwana beds, describing *Palaeomutela glabra* sp. n. and *P. (?) occidentalis* sp. n. from the Los Rastros beds and *Uniona riojana* sp. n. from the Ischigualasto beds.

A. Cabrera (*Notas Mus. de la Plata, VIII*, p. 317) in 1943 described the first therapsid reptiles recorded from the Argentine, two of them being assigned to the Diademodontidae. These were named



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*Exaeretodon frenguelli* g. et sp. n. and *Theropis robustus* g. et sp. n. A third form was assigned tentatively to *Belesodon*. The material was obtained from the Ischigualasto occurrences of La Rioja.

The same author, in 1944, described a new stegocephalian, allied to *Batrachosaurus*, as *Pelerocephalus mendozensis* g. et sp. n. from the Potrerillo valley.

**Bolivia.**—A summary account of the continental Gondwana beds of Bolivia has been given by Ahlfeld, "Geologia de Bolivia" (*Rev. Mus. de la Plata (N.S.) Sec. Geol.* III, pp. 5-370, 1946.) The beds occur in the sub-Andine zone and are divided by him into the Lower Gondwana and Upper Gondwana (or Mandiyuti).

The Lower Gondwana rests with varying degrees of discordance on the Devonian. Its basal portion consists of coarse-grained conglomeratic sandstones, sometimes of conglomerates, which were deposited during a period of rapid erosion of a continental mass situated to the east and of quick transport with intervals of lesser intensity evidenced by argillaceous beds. There followed a period when deposits were laid down by glacial action (Tarija formation). The glacial beds (clay-grits) are more strongly developed in the south than in the north, reaching a maximum thickness of 400 metres.

The Upper Gondwana beds display a very variable development. The deposits were laid down after an interruption of sedimentation following the Tarija formation which suffered erosion prior to the Mandiyuti deposition. The Mandiyuti was a period of rapid erosion and intense transport, evidenced by the conglomeratic character of its basal portion, which attains a thickness of 400 metres. The upper part of the Mandiyuti, especially in the north, is characterized by thick cross-bedded reddish-coloured sandstones which resist weathering and are thus prominent as escarpments. According to Schlagintweit these indicate a hot arid climate, in contrast to the cold climate which existed during the deposition of the Tarija beds.

**Brazil.**—Von Huene (*Physis*, t. XIV, 1939) discussed the age of the reptile-bearing beds (upper Rio do Rasto beds) in Rio Grande do Sul which have yielded *Anomodontia* and *Cynodontia* mingled with *Pseudosuchia*, *Rhynchocephalia* and *Saurischia*. He considered the age of these beds to range from the base of the upper Muschelkalk to the base of the upper Keuper, and considered them, on palaeontological grounds, to be the equivalent of the Molteno beds of South Africa.

Much more extensive collections of the Rio do Rasto fauna than that described by von Huene have been made by Price and White. Two giant anomodonts and a new pseudosuchian have been described. Romer states, however, that small dicynodonts are present; and it is possible that the beds will be capable of subdivision and that the lower portion may be equivalent to part of the South African Beaufort beds.

Oliviera Roxo (*VIII Am. Sci. Congress*, vol. 4, 1940) listed the fossil plants of Permo-Carboniferous age from Brazil and discussed the prevailing climate which they indicate.

V. Leinz (*N.J. f. Min.*, Beil.-Bd. 79, Abt. B, 1938) considered the Permo-Carboniferous glacial sediments of Brazil from the petrographic and geological standpoints. He concluded that, with the exception of the uppermost tillite of Santa Catharina, the Brazilian tillites were true ground moraines and that the sandstones, shales and varved clays intercalated between the tillite horizons were derived by weathering of the tillites themselves. The ice-sheets which produced the tillites covered a large flat area.

**Belgian Congo.**—J. Lepersonne (*Bull. Serv. géol. Congo belge*, No. 1, 1945) has re-defined the Karroo succession in the west and south-west of the Congo basin, excluding from that system the Lubilash (or Sankuru) beds and placing these in the Kalahari system.

As thus defined, the Karroo system (Lualaba) in the area named is subdivided into

5. Soft, brick-red, sandstones with lenses of chalcedony: several metres thick.
4. Soft sandstones, brick-red, yellow or white: about 90 metres thick.
3. Red mudstone, with greenish arenaceous zones, fossiliferous (*Darwinula* sp., *Estheria* sp., fish): 1-3 metres thick.
2. Soft brick-red sandstones, with conglomerate bands, calcareous bands, and bands of red mudstone and hard sandstone: maximum thickness 300 metres.
1. Basal conglomerate: several metres thick.



Lepersonne considers also that the Lunda beds of Angola should be correlated with the Kalahari beds and that only the Cassanje stage, ranging from the basal glacial conglomerate up to the top of the *Estheria mangaliensis* beds, should be attributed to the Karroo system.

L. Cahen, A. Jamotte, J. Lepersonne & G. Mortelmans (*Bull. Serv. géol. Congo belge*, No. 2, Fasc. II, 1946) have given the latest review of the Karroo beds in the Belgian Congo. Accepting the term "Karoo system," they divide the system into three series, whose characters are here briefly summarized.

*Kwango series* (formerly known as Lubilash stage, Sankuru stage, Lualaba stage, Kwango stage). Composed of soft sandstones with more or less important intercalations of shales and conglomerates and, locally, calcareous zones; colour characteristically brick-red, passing to white or yellow. At the base, more or less continuous conglomerates. Thickness may exceed 400 metres.

Fossils rare, consisting of phyllopods (*Estheria mangaliensis* var. *angolensis*, *Estheriella moutai*, *Estheria draperi*?), an ostracod (cf. *Darwinula globosa*), fish remains, and cf. *Glossopteris*. Considered to be the equivalent of the South African Molteno beds and Red beds.

*Lualaba series* (formerly part of the Lualaba stage). Consists of mudstones, marls, and soft shales (red, green, grey, or variegated in colour) with arenaceous intercalations and calcareous horizons. There are frequent horizons of bituminous shales and locally (in Katanga) thin beds of bituminous coal. Locally, sandstones with plant debris may occur at the top, and sandstones or conglomeratic sandstones at the base. Maximum thickness about 200 metres.

Fossils abundant:—

Phyllopods (*Estheriella lualabensis*, *Estheria* sp.).

Ostracods (*Darwinula globosa* var. *stricta*, *Metacypris passau*).

Fish (*Peltopleurus maeseni*, *Pholidophorus corneti*, *Lepidotus congolensis*, *Colobodus* sp.).

Plants (*Glossopteris browniana* var. *indica*, *Nummulospermum* sp.).

Considered to be equivalent to the Middle Beaufort and possibly the base of the Upper Beaufort of South Africa.

*Lukuga series*. The series is subdivided into two stages, each comprising two substages.

*Upper stage* (known at present only in Katanga).

1. Transition beds: sandstones, shales, thin carbonaceous beds. Locally calcareous shales.

2. Coal Measures: shales and mudstones, sandstones (fine and coarse), abundant pyrite, beds and veins of coal.

Fossils: *Noeggerathiopsis hislopi*, *Phyllothea zeilleri*, *Glossopteris browniana*, *Glossopteris indica*, *Ullmannia*, *Strobolites*, ? *Voltzia*, *Schizoneura*.

*Lower stage*.

1. Black shales: Grey and black shales, often pyritic.

2. Niemba beds: tillite with shales and sandstones which are often red, fluvio-glacial conglomerates, feldspathic sandstones.

Maximum thickness: 250–300 metres

Fossils: *Gangamopteris cyclopteroides*, *Cyclodendron lesliei mathieui*, *Noeggerathiopsis hislopi*, *Glossopteris* sp.

Considered to be equivalent to the lower part of the Beaufort series and the Eccia series of South Africa. Some authors consider that part of the lower stage may correspond to a part of the Dwyka series.

The authors consider that there is thus a time-break between the end of the Lualaba series and the beginning of the Kwango series, and—except in Katanga—another break between the top of the lower stage of the Lukuga series and the base of the Lualaba series.

Duparque in 1935 published the results of a microscopic study of the Luena and Lukuga coals and concluded that

(1) the organic material could very easily have been transported by running water or even by wind, and that the coals are allochthonous in origin;

(2) the transportation was prolonged and in disturbed water;

(3) the cell-structure of certain plant remains shows the presence of seasonal variations;

(4) spores and pollen-grains play an important rôle in the formation of these coals.

*Southern Rhodesia*.—In its Bulletin 38 ("An Outline of the Geological History of Southern Rhodesia") published in 1947, the Geological Survey of Southern Rhodesia has departed from the use of the names used in South Africa for subdivisions of the Karroo formation and has adopted a division into Permian and Triassic. Between the two is a marked unconformity.

The Permian system is the coal-bearing system of the country. It has been most intensively studied in the Wankie coal-field, where it is divisible into a Wankie series below and a Madumabisa series above. The Wankie series has been divided into

4. Upper Wankie sandstone.
3. Fireclay.
2. Black shale and coals.
1. Lower Wankie sandstone.

The Lower Wankie sandstone is composed of fine and coarse sandstones with occasional lumps of granite and thin beds of black shale. At the top is a bed of laminated grey micaceous sandy shale, about twenty feet thick, on which rests the main coal seam. This shale is considered to have been formed in moderately deep stagnant water. The coal of both the main and upper seams is considered to be drift coal.

The Fireclay is local in its distribution and passes up into red micaceous Upper Wankie sandstone which is overlain by coarse white feldspathic sandstone. Thin beds of coal and shale occur in this stage, which has yielded a flora containing *Glossopteris*, *Cordaites*, *Sphenopteris*, *Pecopteris*, *Cyclodendron* and other Lower Karroo genera, making the beds comparable with those of the Middle Ecce of the Union of South Africa.

The Madumabisa shales have numerous concretions of iron ore near their base, above which they are grey or green shales with numerous beds and nodules of septarian limestone. Thin seams of coal occur in the lower part. The stage has yielded freshwater lamellibranchs and an ostracod and reptilian remains of *Dinocephalia*, typical of the Lower Beaufort beds of the Union.

The Triassic system has a much wider distribution than the Permian. It is composed almost entirely of arenaceous sediments overlain by basaltic volcanics. The sediments show the following succession:

5. Nyamandhlovu sandstone (aeolian).
4. Forest sandstone.
3. Pebbly arkose.  
(Minor unconformity).
2. Fine red marly sandstone.
1. Escarpment grit (basal conglomerate).

The fine marly sandstone has yielded plants identified as *Thinnfeldia* spp., *Taeniopteris*, and *Schizoneura*; while the Forest sandstone contains bones of Theropodous dinosaurs. The sandy rocks of the Triassic are considered to have been deposited under climatic conditions which were getting increasingly dry until aeolian desert sandstones were deposited at the top.

*Union of South Africa.*—The sinking of several deep boreholes to intersect various parts of the Karroo succession in the southern part of the Karroo in the Cape Province and of one borehole near Kestell in the Orange Free State has yielded samples of fresh rocks at depth. Dr. H. J. Nel of the Geological Survey has begun a detailed petrological examination of cores of rocks belonging to the Ecce series in both areas and has obtained information which is summarized here.

#### 1. Southern Karroo Area.

The core chosen for examination was obtained on the farm Sambokkraal, Laingsburg division, Cape Province, which lies some thirteen miles west of Merweville, approximately at the intersection of latitude 52° 40' with longitude 21° 20'. The bore passed through 7,426 feet of sediments assigned to the Ecce series. The beds are unaffected by igneous intrusions. In this core the succession has been divided into:

- II. Upper Ecce sandstones and shales (2,618 feet).
- I. Middle Ecce shales (4,808 feet).

The base of the Ecce beds was not reached.

(a) *Middle Ecce beds.* These are composed predominantly of blue-green and blue-grey mudstones which occasionally, and particularly in the lowest thousand feet, have a shaly character due to the development of laminations. Sporadically developed and isolated beds of grit occur in the upper portion. Some 365 feet from the top there is a calcareous grit with numerous plant fragments.

A typical example of grit shows grains of quartz and feldspar with a maximum diameter of 0.20 mm. The grains are predominantly angular. Strain extinction is well developed, and needle and bubble inclusions prevalent, in the quartz



grains. The feldspar (albite) is comparatively fresh. Calcite is present interstitially. Chlorite, microcline, and nontronite are accessory.

The argillaceous rocks are calcareous in varying degrees, the secondary calcite being present as narrow veins sometimes associated with secondary quartz and pseudo-coal or as irregular, approximately equidimensional bodies up to 0.3 mm. in diameter. These latter are segregations and not fossil remains. The clay constituent is so fine-grained as to defy any attempt at identification by ordinary microscopic methods. There is, however, sometimes a degree of similarity in optic orientation of individual grains, resulting in the simultaneous extinction of irregular areas under crossed nicols. The mudstones often contain isolated, angular fragments of quartz and feldspar, which may be up to 0.08 mm. in diameter but which are usually much smaller. Small nodules of black organic matter, minute rutile individuals and muscovite flakes are other accessory constituents, as well as finely dispersed greenish chlorite.

Gradations between arenaceous and argillaceous sediments are also encountered; these incorporate mineralogical and textural characteristics which are similar to those found in the two main groups of sediments.

(b) *Upper Ecça beds.* These are predominantly arenaceous and consist of feldspathic grits, shales, and mudstones. They are similar to the overlying Lower Beaufort beds save that purple shales do not occur.

The arenaceous rocks are usually grey or blue-grey in colour, frequently mottled with white, and are fine-grained. Some purplish and brown-grey grits are present. Cross-bedding is of frequent occurrence and is accompanied in cases by over-curling of individual grit layers. The diameter of the average quartz and feldspar grains varies from 0.1 mm. to 0.25 mm. Very seldom indeed is the latter figure exceeded. The grains are almost invariably angular to subangular; rounded grains are very scarce. The quartz grains have highly irregular shapes, but those of feldspar tend to be squat tabular in form. The quartz grains usually show marked undulose extinction and contain liquid and gas bubble trains as well as numerous needle inclusions. The predominant feldspar encountered is albite with approximately 8 per cent anorthite. Very often the feldspar is sericitized although perfectly fresh grains are present. Twinning lamellae may be straight and even, or slightly bent or, rarely, highly irregular. A fair percentage of the albite has a reddish colour. Rough estimates show that the feldspar may constitute up to 25 per cent by volume of most of the arenaceous rocks; the figure does not seem to fall below 10 per cent in any sample examined. In one thin bed of porous grit, sericitized albite grains have a mantle of clear fresh albite of approximately the same composition as the cores. These mantles (up to 0.02 mm. in width) obviously post-date the deposition of the sediment. Most of the feldspar grains are allogenetic; a few, which have a textural relationship to the adjacent grains, are clearly authigenic. In the medium-grained grits isolated grains of clear allogenetic microcline are occasionally seen. The cementing material, which is fairly scarce, may be argillaceous, calcitic, or of chalcedonic silica. In the mottled grits, patches of rock are cemented by calcite in optical continuity. The most prevalent accessories are pyrite (as cubes), nontronite, chlorite, muscovite, iron oxide, chalcedonic silica, and zoisite. Of the heavy minerals present, a light-coloured reddish-brown garnet ( $N_D = 1.80 \pm 0.01$ ) is most abundant; colourless zircon, both as idiomorphic and as rounded grains, is present, as are a little apatite and a few grains of epidote.

The mudstones are usually blue, blue-green, grey, or greenish in colour, and occasionally contain thin sandy layers which are often cross-bedded. They are similar in texture and composition to the argillaceous rocks of the Middle Ecça beds.

## 2. *Eastern Orange Free State.*

The core examined is from a borehole on Brakfontein 953, Harrismith district, situated at approximately latitude  $28^\circ 22'$ , longitude  $28^\circ 46'$ . It is distant 540 miles (864 Km.) from the hole at Sambokkraal. The hole passed through the complete Ecça series, which here consists of 1,416 feet of sediments into which were intruded dolerite sills whose total thickness is 1,277 feet. The Ecça series is subdivided into:

Upper Ecça stage 827 feet.

Middle Ecça stage 469 feet.

Lower Ecça stage 120 feet.

(a) *Lower Ecça stage.* This is composed of blue-grey mudstones some of which show, locally, a remarkably wide variation in the grain size of the constituents. Angular to rounded quartz grains up to 0.1 mm. in diameter and polysynthetically twinned plagioclase and occasionally fresh microcline occur at random in the extremely fine-grained argillaceous groundmass. The quartz grains show strain extinction. Accessory minerals are finely disseminated chlorite, leucoxene, sericite, biotite and rutile.

(b) *Middle Ecça stage.* This consists of a succession of shales, mudstones, arkoses and grits.

Among the argillaceous sediments fissile shales are fairly prominent. Most frequently they are carbonaceous, the black carbonaceous material being extremely fine-grained and evenly distributed. The well developed fissility is due to the presence of much micaceous material (muscovite). Although essentially very fine-grained, the shales often contain quartz grains, unrounded and often in the form of sharp slivers, up to 0.75 mm. in length. Fresh tabular fragments of microcline and albite may also be in evidence. Biotite and nontronite are accessories.

The arenaceous sediments as a group are a great deal coarser in grain than any seen elsewhere in the Ecça.

Below the first shale band in the stage is a bed, some 50–60 feet thick, consisting of medium to coarse sandstones, grits, and arkoses. Individual grains in this bed may attain a maximum diameter of 3 mm., although grains of this size



are rare and usually consist of microcline. The average grain size varies from 0.5 mm. to 1.5 mm. The rocks are composed mainly of angular, subangular and rounded grains of quartz and feldspar (fresh microcline and fresh to sericitized albite). The constituent grains appear to be, on the whole, more rounded than in the fine-grained arenaceous rocks of the Ecça, both here and elsewhere. The most abundant feldspar is microcline, mostly fresh, in grains which vary in shape from perfectly rounded individuals to tabular fragments that have undergone no abrasion. Fresh to sericitized albite, sometimes of a reddish tinge, is always subordinate to microcline. Thin books of muscovite, with the C-axis approximately perpendicular to the bedding planes of the rocks, are well represented and may attain a diameter of more than 3 mm. Clay is present as a cementing medium; calcite may fulfil the same rôle locally. Cement is not abundant.

Garnet is the most abundant constituent of the heavy residues from these arkosic rocks. Two varieties appear to be present, a red-brown type ( $N_D = 1.805 \pm 0.005$ ) and a light rose-pink type ( $N_D = 1.793 \pm 0.005$ ). Both appear to belong to the almandite-spessartite group. They occur as unrounded, angular grains with conchoidal fracture and uneven cleavage (?) surfaces.

Fluorescent zircon occurs as rounded grains and as complete crystals with terminal faces developed at both ends. Among the other minerals present, in lesser amounts, are titanite, apatite, and ilmenite. Galena also occurs in the form of little crystals, sometimes distorted, but showing no signs of abrasion.

Below the carbonaceous shale horizon (20 feet thick) with its thin seams of vitreous black coaly material, which underlies the arkosic rocks just described, is a succession of feldspathic grits with somewhat different characteristics from those of the arkoses. These rocks are whitish to greyish in colour, are micaceous, and occasionally show a well laminated structure with the sporadic development of thin layers, less than 3 mm. thick, of coaly material. The texture is fine to medium grained.

In the upper portion of this arenaceous zone are found medium-grained feldspathic grits or fine-grained arkoses, the average grain size being a quarter of a millimetre. The constituent grains of quartz and feldspar are angular to subangular and are not well sorted. Among the feldspar grains reddish and fresh polysynthetically twinned albite is at least as abundant as microcline.

Lower in the zone the rocks are finer-grained and the constituent grains are better sorted, with argillaceous and sericitic material forming the cement between them. The feldspar here is almost exclusively slightly altered albite.

The heavy mineral assemblage of this zone differs from that of the arkoses by the absence of galena and the presence of small plates of what is possibly pyrrhotite. Both these minerals appear to be authigenic when present, and it is not improbable that the dolerite intrusions are their source.

(c) *Upper Ecça stage.* This consists predominantly of mudstones, whose petrological characters do not differ from those of the Lower Ecça stage. Their colour varies from dark grey-black to grey with either a greenish, bluish, or brownish tinge. Carbonaceous matter is responsible for the blackish colour of some.

*Madagascar.*—From Dr. H. Besairie we have received an account (dated 15th November, 1947) which incorporates the latest information on the petrographic constitution of the Karroo sediments of Madagascar and which considers the palaeoclimatology of the area in Karroo times. This account is given in its entirety.

“Le Karroo malgache comprend tous les terrains à facies continentaux qui se sont déposés, sur le vieux socle métamorphique, du Carbonifère au Bathonien. Cet ensemble se divise en trois groupes, séparés par des discordances: Sakoa, Sakamena, Isalo. La présence d'intercalations marines fossilifères et des restes de Vertébrés permet d'effectuer des raccords stratigraphiques avec les coupures classiques.

Isalo Eotrias supérieur à Bathonien.

Sakamena Néopermien à Eotrias inférieur.

Sakoa Carbonifère à Eopermien.

J'ai donné, en 1946 (*Ann. Geol. Serv. Mines*, Fasc. XII) un tableau d'équivalences. Une découverte récente permettant de rattacher à des Phytosauridés, des restes primitivement attribués à des Précoodiliens, amène à placer la base de l'Isalo, II, vers le début du Rhétien. Cette coupure correspondrait au Rhétien et au Lias.

Dans l'évolution climatique de Madagascar pendant le Karroo, plusieurs particularités sont à souligner. En premier lieu, pendant toute la durée du Karroo, il existait, tout le long de l'axe du Madagascar actuel, une chaîne montagneuse où les dernières manifestations tectoniques et métamorphiques datent du Dévonien (Schistes à *Lépidodendrées*). Cette chaîne avait une digitation vers l'Ouest correspondant au seuil gneissique du Cap Saint André. En outre, dès le début du Karroo, un ennoyage se dessine entre Madagascar et l'Afrique où la mer pénètre dès le Permien inférieur. A ce moment, des mouvements tectoniques (discordance de la Sakamena) rajeunissent le relief. Il en sera de même après le dépôt de la Sakamena avec la discordance de l'Isalo.

La proximité d'une haute chaîne, les influences marines et les rajeunissements du relief constituent des points importants dans la paléoclimatologie malgache.

#### *Groupe de la Sakoa.*

*Schistes noirs et Conglomérats.*—Cette formation, épaisse d'une centaine de mètres au maximum, comprend des conglomérats et des schistes noirs. Les conglomérats sont des tillites glaciaires, argiles à blocs classiques à gros éléments,

anguleux et à faces polies, d'éléments cristallins noyés dans une pâte bleuâtre constituée de fragments anguleux de quartz de feldspath, de grenat, le tout cimenté par de l'argile colloïdale. Les schistes noirs, plus ou moins pélitiques, très fissiles, sont formés d'éléments très fins; ils renferment des empreintes de *Schizoneura*. Associés avec eux se trouvent quelques grès fins ou mi-grossiers. Schistes et grès représentent des couches interglaciaires.

*Couches à Charbon.*—C'est une formation surtout gréseuse, d'une épaisseur de 50 à 200 mètres, avec des grès durs, fins ou grossiers, parfois conglomératiques, avec bancs de schistes, souvent micacés et des couches de charbon. Les grès sont fréquemment feldspathiques et les feldspaths sont inaltérés. Ils renferment des concrétions pyriteuses ou ferrugineuses. La flore comprend l'association *Gangamopteris* (avec de nombreuses variétés), *Glossopteris*, *Schizoneura*. La nature, plutôt fine des grès, l'inaltérabilité des feldspaths et des micas, l'absence de couches rouges indique un régime tempéré sans forte précipitations. C'est là le climat de la flore à *Glossopteris*, avec régime humide.

*Série rouge inférieure.*—Au-dessus des couches à charbon vient un complexe argilogréseux, épais de plusieurs centaines de mètres, comprenant de gros bancs d'argilites rouges, des grès verts, assez grossiers à feldspaths roses inaltérés, des grès fins micacés. La flore comprend de rares Bois silicifiés et quelques *Glossopteris*.

La présence des argilites rouges, dès la base de l'étage, indique un changement climatique avec régime sec ou semi-aride, mais l'alternance de grès fins micacés, de grès à feldspaths inaltérés montre une persistance, au moins intermittente, d'un régime tempéré.

*La Première Transgression marine.*—Correspondant à la première ouverture du Canal de Mozambique vers le début du Permien moyen, les dépôts calcaires de Vohitolia et du Ianapera nous ont fourni: *Productus*, *Spirifer*, *Avicula*, *Scaldia*, *Soleniscus*, faune de mers peu profondes, et aussi des Polypiers et des Algues indiquant que ces mers étaient chaudes.

Les dépôts marins de ce niveau dans le Nord de l'île représentés par les grès à *Productus* d'Ankitokazo renferment une faune plus riche avec un Coralliaire: *Cyathophyllum*, des Brachiopodes: *Spirifer*, *Productus*, *Camarophoria*, *Athyris*, des Lamellibranches, un Céphalopode: *Xenaspis carbonarius*, vivant aussi en milieu littoral ou néritique de mer chaude. Cette faune qui appartient au domaine équatorial du Permien inférieur et moyen, présente surtout des affinités avec l'Oural et l'Inde. Une seule espèce: *Athyris* (*Semilunea*) *argentea* Shephard appartient à la fois au domaine équatorial et au domaine boréal.

*En Résumé.*—Le groupe de la Sakoa nous montre un passage continu du glaciaire au tempéré, puis au climat chaud, avec régime semi-aride intermittent au sommet.

#### Groupe de la Sakamena.

Le groupe de la Sakamena renferme vers sa base, quelques intercalations marines avec un Coralliaire: *Cladochonus*, des Lamellibranches: *Aviculidés*, *Pteria*.

*Conglomérat de Base.*—Formation épaisse parfois de 40 à 80 mètres, d'un poudingue à galets de roches cristallines, cimentés par une pâte siliceuse ou psammitique. Ce conglomérat fait suite au rajeunissement du relief après des mouvements post-Sakoa.

*Complexe Schisto-Gréseux.*—Ce complexe peut atteindre une épaisseur d'un millier de mètres. Il comprend une alternance de grès psammitiques et de schistes pélitiques. Les grès sont généralement fins, micacés, se débitent en dalles ou en prismes. Il y a quelques couches à stratification entrecroisée. Les schistes pélitiques sont sombres; ce sont des vases ou des boues durcies et cimentées dont les constituants sont d'une extrême finesse. Ils sont parfois très fissiles et comportent aussi des miches calcaires ovoïdes, aplaties, quelquefois fossilifères. Dans la région Sud du Cap Saint André, il y a quelques couches charbonneuses.

La faune renferme des Reptiles: *Hovasaurus*, *Tangasaurus*, *Coeluresauravus*; un Amphibien: *Rhinesuchus*; des Poissons: *Atherstonia*, *Semionotus*, *Colobodius*. La flore renferme, à la base, *Glossopteris* et *Schizoneura* et, à un niveau plus élevé: *Pecopteris*, *Cladophlebis*, *Thinnfeldia callipteroides*, *Supaia*, *Lepidopteris*, *Ginkgophyllum*, *Voltzia*, *Brachyphyllum*, *Toeniopteris*, *Daneopsis*, *Noeggerathiopsis*. *Glossopteris* y persiste mais avec une fréquence très rare. Dans son ensemble, cette flore présente des caractères xérophiles accentués.

Cet ensemble continental, bordé par des mers chaudes, témoigne d'un climat chaud où le caractère xérophile de la flore indique une sécheresse relative mais où la formation des vases pélitiques exigeait néanmoins une certaine humidité.

*Série rouge supérieure.*—Formation assez puissante (100 à 300 mètres), souvent masquée par la transgression de l'Isalo, constituée d'argilites rouges et vertes, avec quelques grès tendres, clairs, à stratification entrecroisée. On n'y connaît pas de fossiles. Nous avons là un régime climatique nouveau, où les argilites rouges indiquent l'établissement de périodes semi-arides.

*Equivalents marins.*—Parallèlement aux dépôts continentaux, les mers déposaient, dans le Nord de Madagascar, d'abord des dépôts littoraux à Ammonites à Poissons avec, parmi ces derniers, des types à formes élevées caractéristiques d'espèces vivant autour de récifs coralliens et, ensuite, d'autres Ammonites, affines de l'Himalaya, de la Salt Range et aussi de l'Idaho (couches à *Flemingites*).

*En Résumé.*—Le groupe de la Sakamena débute par un climat où règne une humidité suffisante pour permettre le dépôt de sédiments fins, argileux et des charbons du Cap Saint André, mais qui diminue comme l'atteste le caractère xérophile de la flore pour atteindre une semi-aridité à la fin.



## Groupe de L'Isalo.

*Conglomérat de Base.*—Le groupe débute par un nouveau conglomérat à galets de roches cristallines et plus rarement sédimentaires, qui fait suite à de nouveaux mouvements post-Sakamena.

*Isalo I.*—Au-dessus du conglomérat de base, l'Isalo I est surtout composé de grès clairs grossiers, souvent conglomératiques, mal cimentés, à feldspaths kaolinisés, épais de plusieurs centaines à 2 et 3,000 mètres. La stratification entrecroisée est de règle constante, atteignant une très grande ampleur. On ne connaît pas de fossiles. La très forte épaisseur, l'abondance des grès grossiers et des galets roulés de quartz est la résultante d'un climat à précipitations abondantes, où une érosion intense désagrégeait les roches cristallines du socle. La décomposition des feldspaths, et la présence occasionnelle de couches rouges montre que ce climat était également chaude. A la limite supérieure de ces couches, un banc marin présente des Eponges calcaires (*Lithistides*).

*Isalo II.*—Au-dessus de l'Isalo I, ce nouvel ensemble, dont l'épaisseur peut atteindre un millier de mètres, est caractérisé par l'association de puissantes couches ou lentilles d'argilites rouges, plus rarement vertes ou bigarrées, et de grès clair tendres, moins grossiers que ceux de l'Isalo I, à stratification entrecroisée, avec concrétions calcédonieuses. On y trouve des restes fossiles: dents et plaques dermiques de *Phytosauridés*, ossements divers, dents de *Ceratodus* et surtout des Bois silicifiés abondants et de grande taille: *Araucarioxylon*, *Cedroxylon*, *Dadoxylon*, dépourvus d'anneaux d'accroissement. L'absence de branches adventives indique qu'ils ont subi un long transport. Il existe quelques lits de lignite. Par endroits, on connaît des concentrations salines chlorurées et sulfatées.

Au Nord du Cap Saint André, les facies sont mixtes ou marins. Il y a vraisemblablement une lacune partielle correspondant au Rhétien. Dans la région de Kandrehô on trouve, au-dessus grès de l'Isalo I, des argiles bariolées à gypse, des bancs grésocalcaires à *Myophoria vulgaris* et *Mytilus psilonoti*, puis des argiles, schistes bitumineux et lignites alternant avec des calcaires marins du Lias. Plus loin, vers Nossi Bé, il y a des argiles, des grès, puis des alternances de grès, d'argiles et de schistes à charbon et à Plantes: *Pecopteris*, *Equisetum*, *Brachyphyllum*, *Araucarites*, *Yuccites*, des marnes et calcaires marins (*Dumorteria*, Polypiers).

Au Sud du Cap Saint André, les facies sont continentaux. Il y a un changement de facies très net à mesure que l'on descend vers le Sud. Dans la région de Morafenobe, on trouve une alternance d'argiles multicolores, rouges, vertes, bleues, brunes, avec lignite, et de grès fins à stratification entrecroisée, le tout très riche en gros Bois silicifiés. Au Sud du Manambolo, les argiles disparaissent momentanément ainsi que les Bois silicifiés. Dans la région du Mangoky, on retrouve des argiles principalement rouges avec concentrations salines et des grès à stratification entrecroisée, sans Bois silicifiés.

Tout ceci paraît indiquer une forte aridité dans le Sud (argiles rouges du Mangoky avec sel), qui diminue à mesure qu'on approche du seuil cristallin du Cap Saint André (argiles multicolores, lignites, abondance des grands Bois silicifiés). Au Nord, l'aridité reprend à la base de l'étage (argiles rouges, gypse) pour diminuer par la suite (lignite, charbon).

Il semble donc que l'Isalo II marque un établissement de l'aridité, surtout dans sa partie inférieure, tempéré toutefois par les influences humides de la chaîne montagneuse orientale d'où dévalaient des fleuves charriant les grands Bois et les sables qui forment les dépôts entrecroisés.

*Isalo III.*—L'Isalo III, correspondant au Bajocien et à la première partie du Bathonien comprend, dans son facies continental franc, des grès clairs, plus généralement fins que grossiers, à stratification entrecroisée, avec lits conglomératiques, quelques argilites rouges. On y connaît dans la partie moyenne, de rares lits de lignite, de grands Bois silicifiés à ramures adjacentes conservées, et, au sommet, des Bois calcaires. Au sommet également, on trouve des formations saumâtres à *Corbula* et de nombreux restes de *Bothriospondylus*.

Cette formation comporte de nombreuses intercalations marines qui arrivent à prédominer dans certaines régions. Ce sont toujours des mers chaudes à Coraux.

La nature entrecroisée des grès continentaux avec lits de galets, le peu de fréquence des argiles rouges, les mers à Coraux, indiquent un régime chaud et humide.

## Conclusion.

On peut se représenter comme suit, l'évolution climatique, à Madagascar, durant le Karroo. Après la période glaciaire vient une période tempérée humide, de plus en plus chaude, avec dépôts de charbon qui aboutit à un stade semi-aride temporaire, à la fin du groupe de la Sakoa, sur les bords de la mer chaude du Permien. Après les mouvements tectoniques post-Sakoa qui entraînent une première surrection du massif cristallin (pendages de 30° à 40° dans le groupe de la Sakoa sur les flancs du massif), un régime chaud et humide se rétablit qui se dessèche progressivement pour aboutir à une semi-aridité à la fin du groupe de la Sakamena. Avec de nouveaux mouvements tectoniques post-Sakamena, un nouveau rythme reprend avec un régime particulièrement humide qui déposera l'épaisse série arénacée grossière à stratification largement entrecroisée de l'Isalo I. Dès l'Isalo II, un changement brutal se produit avec l'établissement d'un régime à tendance aride (argiles rouges, sel, gypse), tempéré localement par l'humidité de la région montagneuses orientale qui se manifeste par d'abondants apports fluviaux. Au cours de l'Isalo III, l'aridité fait place à un climat chaud et humide.

Il est bon de remarquer que les tendances à l'aridité à Madagascar n'atteignent jamais le stade désertique. La très grande majorité des grès présente, en effet, une stratification entrecroisée d'origine torrentielle et non éolienne. Le maximum d'aridité correspond aux gros dépôts d'argiles rouges à *Ceratodus* et *Phytosauridés*, attribuées au Rhétien."



# COMMISSIONS

*India*.—From shales almost immediately above the Talchir boulder-bed M. C. Jacob has described spores which are considered to belong to *Glossopteris* and are indistinguishable from spores found by the same investigator in the Bacchus Marsh tillite of Australia. These discoveries show that the *Glossopteris* flora was in existence in Gondwanaland at least during the latter part of the glacial period.

As a supplement to the paper referred to in an earlier part of this report, Dr. (now Sir Cyril) Fox sent to the Secretary at the end of 1938 the following information.

"This note is prepared as a supplement to the paper read before the Paleontological Union in Moscow, in July, 1937, on 'The Climates of Gondwanaland during the Gondwana Era in the Indian Region,' which is being published in the Comptes Rendus of the meetings of the Seventeenth International Geological Congress. The geological succession of the Gondwana formations shown in the table below differs slightly, but in no important detail, from that accompanying the paper read at Moscow, and is, like the other, a compromise to meet new views which have gained acceptance by recent studies of the fauna and flora of the Gondwana strata in India and adjacent lands.

## *Permo-Triassic strata of the Gondwana System.*

	INDIAN PENINSULA	PUNJAB	KASHMIR	
Upper Gondwanas	Rajmahal	Rajmahal plant beds Kota, Dubrajpur beds	Oolitic Lias	Jurassic
	Mahadevas	Denwa-Pachmarhi beds Tiki-Maleri reptilian beds	Rhaetic Keuper	Triassic
Lower Gondwanas	Panchets	Parsora plant beds Mangli, Deoli bone beds	Ceratite beds Monotis shale Otoceras bed	
	Damudar	Raniganj, Bijori, etc. Motur, Ironstone Shale, etc. Barakar-Karharbari (Umaria marine bed)	Upper Middle Lower Productus Limestones Zewan beds Gangamopteris beds	Permian
	Talchirs	Rikba plant bed Dark nodular shales Boulder bed (glacial)	Eurydesma beds Nagmarg beds Agglomeratic Slate Series	Carboniferous
			Uralian Muscovian	

Particulars of the various formations in the above table will be found in "The Gondwana System and Related Formations<sup>1</sup>," where the Moturs are wrongly correlated with the Denwas and the *Eurydesma* beds are included in the Speckled Sandstones. The divisions of the European Permian are given in the new Russian nomenclature of the type area between the Urals and the Volga, where the base of the Artinskian now includes all beds which contain *Pseudofusulina lutugini*<sup>2</sup> and thus part of what was Upper Carboniferous. The Domennaya breccia at Simskaya at the base of the Artinskian is probably the debris of a marine landslip<sup>3</sup> as it, petrologically, in no way resembles the Talchir boulder bed, the Salt Range tillite nor the Dwyka boulder bed of Umgeni which from my personal observations I was able to explain to the Soviet geologists during the Permian excursion in July, 1937.

In the Indian peninsula the Talchir series have a maximum thickness of 800 feet, of which the boulder bed, at its greatest, never includes more than 100 feet at or near the base of the Series. The overlying deposits are clearly sediments,

<sup>1</sup> *Mem. Geol. Surv. Ind.*, LVIII, 1931.

<sup>2</sup> *Bull. American Assoc. Petrol. Geol.*, Vol. 22, No. 6, July, 1938, p. 775. Some geologists would place the Schwagerina beds (Sakmarian) also in the Lower Permian.

<sup>3</sup> See Guide Book, The Permian Excursion (Southern Part) *XVIIth Int. Geol. Congress*, 1937, pp. 127-128.

often well laminated but sometimes without evidence of bedding, and always relatively fine-grained and characteristically argillaceous. Black shaly clays with calcareous nodules are occasionally seen, while green splintery shaly clays are generally considered to be the type rock of the Talchirs, especially when accompanied by greenish buff trappoid clays and earthy sandstones. The prevailing colour of the Talchir rocks is greenish buff where freshly exposed, to buff and khaki in weathered outcrops and in rare cases tints of reddish clays where weathering has been prolonged in damp situations and the clays are slightly calcareous. No animal remains, except a doubtful wing of an insect, have been found in the Talchir, but plant remains, particularly *Gangamopteris* (leaf), have been obtained in several places in the top of the Talchir Series. The prevailing greenish colour, the argillaceous character of the strata and the presence of fronds of plants without fossil wood, suggest that these beds were laid down by sluggish streams in wide valleys in a cold climate.

If the *Eurydesma* beds of the Punjab Salt Range and the Nagmarg beds of the Kashmir area are the true equivalents of the Rikba plant beds, then a not very warm sea existed over the Salt Range and evidently connected with the Australian region but was evidently not in open communication with the relatively warm sea in Kashmir at the close of the Carboniferous. The presence of *Gangamopteris* in the *Eurydesma* beds and in the Nagmarg beds shows that this plant had established itself on the adjacent lands from which debris was carried into both seas. The evidence suggests that warmer conditions prevailed in the Kashmir area than towards Gondwanaland to the south of *Eurydesma* sea of the Punjab Salt Range. If the southern land had been deeply buried by continental ice sheets the removal of the ice would conceivably allow the land to rise slightly by isostatic adjustment, but the sea would encroach on the land in places, due to the vast quantities of water returned to the oceans by the melting of the ice. Evidence in support of this is seen in the encroachment of the *Productus* sea not only into the Punjab but also into the peninsular region in Central India (South Rewa) at the beginning of the Permian period.

South Rewa is the only place in the Indian Peninsula where the Barakar-Karharbari coal measures overlie marine beds of so-called Permo-Carboniferous age, apparently in a conformable manner, though the latter lie discordantly on the Talchir boulder bed. The Barakar-Karharbari beds constitute the chief coal-bearing strata of India and are entirely of fluvial origin characterized by conglomeratic sandstones, coarse feldspathic sandstones, grey and carbonaceous shales and several coal seams of "drifted" vegetation. The pebbles in the conglomerates are always well-rounded and generally of hard quartzites and in some cases these pebble beds directly overlie coal seams which show no sign of inter-depositional erosion. The feldspar in some of the Barakar sandstones is kaolinized, but careful examinations of these, and especially pebbles of granite above coal seams, show that the alteration has taken place subsequent to deposition. Some pebbles of granite are now so soft owing to kaolinization that they can be kneaded by hand; other pebbles of quartzite show evidence of alkaline corrosion where they rest on a coal seam. It is also evident that many "fire-clays" are in no way related to original soils but are clays from which the alkalis and iron oxides have been leached subsequent to their deposition.

The "Ironstone shales" are an upper unproductive stage of the Barakars and, while containing no coal seams of workable quality and no coarse sandstones, they have well-developed carbonaceous shales with thin bands of siderite. This siderite weathers at the outcrop into limonitic nodules and these in turn suffer dehydration and lie scattered on the surface as lumps of red hematite which were collected for smelting in the early days of the European iron industry in India. The overlying Raniganj measures resemble the Ironstone Shale stage or Barren beds in the relatively fine-grained character of the sandstones and the abundance of shales, but include many workable coal seams. It is not uncommon, either in the Barakars or in the Raniganj coal-bearing stage to find prone tree stems usually as sideritic fossil wood with bright coal as bark—either in the coal seam or resting on the seams. Silicified fossil wood is, however, not uncommon in the upper sandstones of the Raniganj measures. No animal remains at all, if we except the rare specimen of *Gondwanosaurus bijorensis*, have been found in the Damuda series in the Indian Peninsula.

If we assume the presence of coal seams as an indication of abundant forests on the lands from which the vegetable debris was derived, and the richness of the vegetation as evidence of greater rainfall, then the Barakar epoch was more wet than the Raniganj and the intervening time of the Ironstone shales or the Moturs was relatively dry. The Barakars contain upwards of 200 feet of coal in 24 seams of not less than 4 feet and the Raniganj strata must average 120 feet of coal in 16 seams of similar character. Each of these stages contain nearly 2,000 feet of strata in a total of 6,000 for the Damuda series, and, considering the fluvial character of the beds of sandstones, shales and coal seams, it is evident that a slow subsidence must have been in progress throughout the Damuda period. These considerations suggest that although the Damuda sediments were deposited in different areas in Indian Gondwanaland and not everywhere with equal regularity, the climate was probably wet and relatively cold (temperate) in the forest region of the Barakar epoch; somewhat drier but probably still temperate rather than tropical during the Motur epoch; and again wet but evidently considerably warmer in the Raniganj epoch when coal-forming conditions were locally re-established.

The presence of silicified wood in places in the Motur beds and also in the top sandstones of the Raniganj measures is accepted as evidence of local dry conditions and a warm climate, but this does not mean aridity. The most astonishing feature of the Damuda strata is the almost entire absence of animal remains in the peninsular deposits; the one specimen of a vertebrate from the Bijori beds is used as evidence for support of a warm climate at the close of the Damuda epoch. Plant remains, particularly those of *Glossopteris*, of whose anatomical details we still know practically nothing, give no clues as to the temperatures of the climates, but the occurrence of labyrinthodont and fish remains with *Gangamopteris* (leaves) in Lower Permian strata in Kashmir certainly indicate warmth in the areas north of Gondwanaland. The fauna



of the *Productus* limestones of the Punjab Salt Range further supports the idea that the waters of that marine area were warm and suggests, with the related evidence, that the warmth of a region farther north was steadily creeping south and thus changing the climate of Gondwanaland in the Indian region.

Compared with the deposits of the Damuda epoch those of the succeeding Panchet series are almost trifling both in thickness and extent, although its representatives are found in nearly all the basins in which the Damuda accumulated. The strata are generally of variegated colours and in other ways suggest the sediments of a warm to tropical region subject to periods of drought, so as to be on the whole relatively arid. The belief that certain sandstones with fresh feldspar indicated frost and ice is thought to be one way of explaining marked diurnal ranges of temperature, such as occur in Southern Arabia to-day. The *Glossopteris* flora disappeared during the Panchet epoch if we are to judge by the absence of *Glossopteris* and *Schizoneura* from the Parsora plant beds which on somewhat weak palaeobotanical evidence are included in the Lower Gondwanas. That the Panchet epoch was occasionally subject to heavy rain and subsequent floods is shown by the Deoli bone bed which is famous for the collection of vertebrate remains made from it. These reptilian and other vertebrate remains, together with the bones of *Brachyops laticeps* from the equivalent strata in another area, have been claimed to prove that the climate of the Indian region of Gondwanaland had definitely become tropical. The evidence also indicates that at this time climatic as well as physical barriers which might have existed between India and South Africa must have practically disappeared so as to permit free migration of land animals from one region to the other.

Towards the close of the Panchet epoch, while marine conditions persisted over the Salt Range and Kashmir, the wide valleys of the peninsula had become drier, deposition was practically at a standstill and erosion was active. Land conditions were evidently extensive and, owing to the local character of the deposits of this epoch, it is difficult to make a successful correlation. Older vegetation persisted in some damp valleys; the main *Glossopteris* flora evidently could not flourish in the arid, tropical climate that had come upon the land, and a new flora was making its appearance. In this quandary, due to lack of sufficient reliable information and impressed by the reptilian fauna which now wandered across the Indian region of Gondwanaland, some geologists have felt inclined to separate the Panchets and the lower members of the succeeding Mahadevas and group them together as Middle (Triassic) Gondwanas. As the Gondwanas are based on a series of flora and as two of these flora would be included in such a Middle Gondwana division and there is a "break" between them, it seems simplest to leave matters alone until the flora basis of the Gondwanas can be satisfactorily substituted by something more practical and natural.

It is not possible to say definitely whether there was a complete cessation of deposition at the close of the Panchet epoch, but it would appear that early in the Mahadeva epoch local deposition began again under rather similar conditions to those which closed the Panchet epoch. In the new deposits reptilian remains of an Upper Triassic type are preserved and the flora is of the Mesozoic *Ptilophyllum* genera which later flourished in the Jurassic period when the aridity of the Mahadeva epoch was succeeded by the more humid climate of the Rajmahal epoch. The coarse sandstones with occasional silicified wood which accompany the reptilian fossils of the Tiki beds, as well as the red calcareous clays from which the Maleri reptilian remains evidently weathered out, suggest hot, arid regions subject to periodic heavy rains. The same conditions prevailed in the time when the Pachmarhi sandstones and red, calcareous brackish clays of the Denwas were laid down. All these Mahadeva sediments are of fluviatile origin and may have been deposited in shallow basins subject to considerable evaporation. The only vertebrate fossil from the Denwa clays was the fragment of *Mastodonsaurus indicus* which has been regarded as indicating an Upper Triassic (Keuper) age and somewhat younger than the *Hyperodapedon* and *Parasuchus* of the Maleri vertebrate remains.

The brackish nature of the Denwa clays is suggested by the way some exposures of the red clays are licked by cattle and deer, but this clay has not betrayed a saline taste to the observer, so that it may be that animals often lick clays for the clay itself and not for the salt it is supposed to contain. In this connection it is necessary to say that one observer, having found fair-sized pebbles at some horizons of the otherwise clayey beds of the Denwas, has suggested glacial action, but as these are pebbles and the Denwas contain beds of sandstone and in this way resemble the Panchets, the idea of glaciers appears as fanciful as the ice action to explain the presence of fresh feldspars. The same observer has himself noted that the Pachmarhi sandstones pass laterally into alternate beds of sandstone and red clays which increase and become typical Denwa clays. Stray boulders have been found in the Barakar and Raniganj beds, which were also ascribed to floating ice, when the evidence was obviously that they had fallen out of the roots of floating trees. However, the Pachmarhi-Denwa beds are succeeded by strata richer in plant remains and with silicified wood, and indicate the gradual return of humid conditions in a warm climate.

In considering questions of climate as indicated by petrological data it cannot be insisted on too strongly that the red clays are not always originally deposited as such. The descriptions and mode of occurrence of the Moturs of the Pench Valley agree so closely with those of the Denwas and are so entirely different from the typical Moturs as seen in the Tawa Valley that it was believed that the Moturs of the Pench Valley were Denwas. However, a careful examination of the red Motur clays with their segregated calcareous nodules and the occurrence of silicified wood in the associated sandstones indicated that the clays had altered by weathering under the damp conditions of the wide Pench Valley. The effect of this damp, largely showing in the water-bearing nature of the underlying Barakar sandstones, was also apparent in the effects produced in the character of the coal seams in the Barakar sandstones. Where the coal occurs under the red Motur clays or in wet Barakar sandstones its moisture content exceeds 7 per cent and it is non-coking, but in those



areas where erosion has been relatively rapid and the strata are dry, as under water-sheds, the coal averages less than 4 per cent moisture and is generally of coking quality.

Although petrological deductions are sometimes less reliable under strict scrutiny than one may at first believe, there can be no doubt that in the climatic history of the Lower Gondwanas the trend of the evidence is clear. There is a gradual change from wet cold (temperate) conditions in Lowest Permian times to a wet but warmer climate at the close of the Permian epoch followed by a period of increasing aridity and warmth in the Middle Trias. Then in the Upper Trias there is a gradual increase of rainfall under tropical conditions until the humidity in the Lias and Jurassic suffices for the land to be once more clothed with a vegetation sufficiently rich to provide material for coal seams. Throughout the period of the Permo-Trias marine conditions appear to have persisted to the north of Gondwanaland and the warm zones have crept southward from the same direction. The same effect would of course have been obtained if Gondwanaland had steadily "drifted" from an Antarctic position into the tropics during the Permian-Triassic era.

## CLIMATES OF AUSTRALIA DURING THE CARBONIFEROUS, PERMIAN AND TRIASSIC

By CURT TEICHERT

*Prepared for the Commission on the Gondwana System, XVIII International Geological Congress, 1948.*

During the last decade or so, progress has been made in the exact dating of the glacial events of Late Palaeozoic age in Australia. These results should prove to be of more general interest, because in Australia, to a much greater extent than in any other part of Gondwanaland, glacial deposits occur in stratigraphical association with marine sediments. More accurate dating is thus possible.

The oldest glacial beds in the Upper Palaeozoic of Australia occur in New South Wales in the upper part of the Kuttung series. It has now been established (S. W. Carey, *Proc. Linn. Soc. N.S.W.*, 62, p. 355, 1937; S. W. Carey and W. R. Browne, *Jour. Proc. Roy. Soc. N.S.W.*, 71, p. 602, 1938) that the glacial series overlies the *Lithostrotion-Amygdalophyllum* limestone in the Upper Burindi (and Lower Kuttung) which is generally taken as representing the Upper Visean. In the opinion of D. Hill, however, (*Proc. Roy. Soc. Queensl.*, 54, p. 63, 1943) the beds with *Amygdalophyllum* may even be slightly younger than the Visean. The age of the Kuttung glacials, therefore, is at any rate not older than Namurian. It might be later Namurian. A post-Namurian age appears to be ruled out by the flora which contains *Rhacopteris*, *Asterocalamites*, *Lepidodendron*, *Stigmara* and *Cardiopteris* and is definitely of pre-Upper Carboniferous aspect (A. B. Walkom, *Jour. Proc. Roy. Soc. N.S.W.*, 78, p. 6, 1944).

Glacial sediments of Kuttung age are not found outside north-eastern New South Wales. Doubtful varves occur in northern Queensland in the approximately contemporaneous lacustrine Silver Valley beds (W. H. Bryan and O. A. Jones, *Univ. Queensl. Pap., Dept. Geol.*, II, 12, p. 37, 1946). Alternation of glacial and non-glacial sediments in the Upper Kuttung, according to Carey (*op. cit.* p. 367) indicates a succession of glacial and interglacial conditions. There is a lower glacial group representing two glacial advances and an upper glacial group with deposits of three distinct advances, separated by a major break in glacial conditions.

It is unlikely that a continental ice-sheet existed in Australia in Namurian time. The evidence favours the presence of one or more local centres of glaciation in highlands formed during late Lower Carboniferous time (Drummond movement of Carey and Brown, *op. cit.*, 1938, p. 604).

Little evidence is available concerning the climate of Australia before and after the Namurian. Tournaisian and Visean are represented by marine fossiliferous limestones which are in places rich in corals, but the appearance of corals in Palaeozoic rocks does not serve as a climatic indicator other than to suggest that the water temperature probably was not very low. No conclusions as to the climate of the adjacent land are justified.

After the cold period of the Namurian we have a period of somewhat indefinite length from which, apparently, no sediments are known. This period of non-deposition may roughly correspond to the Westphalian (C. Teichert, *Bull. Am. Ass. Petrol. Geol.*, 25, p. 408, 1941). Nowhere in Queensland and New South Wales is there an angular unconformity between Kuttung and equivalent rocks on the one hand and the Permian on the other.

## COMMISSIONS

In the Hunter River Valley of New South Wales the Kuttung glacials are overlain by tillites of the Lochinvar group. Conformable contact and lack of erosion of the older beds suggest shortness of the break between the two rock series. However, short as it may have been, this break was long enough to bring about a complete change in the flora from the older *Rhacopteris* assemblage to the new *Glossopteris-Gangamopteris* flora.

Tillites and aqueo-glacial deposits associated with or slightly preceding the *Glossopteris* flora are widespread in Australia. A summary of the distribution of these rocks was given by David and Sussmilch (*Bull. Geol. Soc. Am.*, 42, 1931, pp. 497-517). Later work by Wade, Teichert and others on previously little known areas in Western Australia has been summarized by Teichert (*Bull. Am. Assoc. Petrol. Geol.*, 31, pp. 20-29, 1947) and in Queensland by Bryan and Jones (*op. cit.* pp. 38-48). The general similarity of these series in widely separated parts of Australia makes it probable that they were all formed at approximately the same time. In the Irwin River area of Western Australia, *Metalegoceras jacksoni* appears in beds 800 feet above the base of the glacials. Its affinities are with Sakmarian species of the genus (Teichert, *op. cit.*, 1941, p. 404). Nowhere else in Australia is an important zone fossil so closely associated with these glacial beds and until further evidence from other parts of the continent becomes available it is suggested that the main Late Palaeozoic glaciation in Australia was of Sakmarian age, although it may have started just prior to the beginning of Sakmarian time. The marine beds in this part of the sequence contain everywhere in Australia impoverished faunas with a small number of species. Associated freshwater beds contain a few species of *Gangamopteris* and *Glossopteris*. On the whole, the evidence for the climate of Sakmarian times suggests the existence of a large ice-cap which must have covered most of Australia, leaving, perhaps, an unglaciated coastal strip of variable width, and the continent was surrounded by a cold sea.

A marked amelioration of climate occurred at the beginning of Artinskian time. Most important Permian faunas of Australia belong to this period. In Western Australia a rise of water temperature and the migration of Tethyan faunas in the general direction from Timor down the west side of the Australian shield is evident at the time of the deposition of the Callytharra and Fossil Cliff limestones. In the early Artinskian, local ice-sheets may have persisted in eastern Australia, but complete cessation of glacial conditions is suggested for mid-Artinskian time, when the Greta coal measures in New South Wales and contemporaneous fresh-water beds elsewhere were deposited (Teichert, *op. cit.*, 1941). Local glaciers seem to have formed again in eastern Australia during late Artinskian time when aqueo-glacial deposits were formed in the Branxton beds in New South Wales, in the Middle Bowen in Queensland and in the upper part of the Irwin River Sequence in Western Australia. No contemporaneous glacial sediments are known from Western Australia. General warming of the waters at least to the west and northwest of Australia is proved by the existence of an enormously rich fauna of Artinskian and Kungurian age in the Timor region (Bitaoeni, Basleo). The influence of this warm water fauna is felt far down the coast of Western Australia at least as far down as 26° N. lat. (Nooncanbah, Liveringa, and Wandagee series).

Few traces of this fauna are found on the eastern side of the Australian continent, where the general similarity of the Upper Marine faunas with those of the Lower Marine suggests continuity of temperature conditions, probably of a moderately temperate nature.

The climate of the mainland must have been cool though not cold enough to cause a general glaciation. The land was dominated by the *Glossopteris* flora, which is generally taken to indicate more rigorous conditions. Furthermore, the insect fauna of Upper Permian age, found in the Upper Coal Measures of New South Wales, is composed of dwarfed forms, "owing no doubt to the severity of the climate" (David, *Expl. Notes to accompany a New Geol. Map of Australia*, 1932, p. 68). Finally we may note the entire absence of reptiles from Permian rocks in Australia which may be due either to geographical isolation of the continent or to unsuitable climatic conditions.

The conditions in Australia during the Triassic are only incompletely known because of the scarcity of rocks of that age. All Triassic strata in Australia are of freshwater origin and characterized by the ubiquitous *Thinnfeldia-Taeniopteris* flora. Climatological evidence afforded by this plant assemblage



## PART I: GENERAL PROCEEDINGS

is as inconclusive as that to be deduced from the occurrence of workable coal seams in Queensland and in South Australia. Stegocephalian life seems to have been richer than in the Permian, although fossil finds are still few and far between. The only Triassic reptile, a cotylosaur, is known from Tasmania. Scarcity of vertebrate life, however, may have been due to geographical isolation rather than to climatic reasons.

The best palaeoclimatic evidence is probably furnished by fossil insects which occur in great profusion in certain beds in New South Wales and Queensland. According to Tillyard (see David, *op. cit.*, 1932, p. 78) this insect fauna is of no small climatological significance. "The abundance of dragonflies and the large size of forms like *Mesotitan scullyi*, some of the cockroaches, *Mesogereon superbum* (ancestor of the Cicadas), *Triassopsychops superba* (ancestor of the silky lacewings), etc., all betoken a prolonged warm climate."

### SUMMARY OF CONCLUSIONS.

During the Lower Carboniferous a normal climate seems to have prevailed which allowed large and varied invertebrate faunas to flourish in the ocean bordering the north and north-east of Australia.

A glaciation, probably restricted to highlands in north-eastern Australia, occurred during Middle Carboniferous or Namurian time. Several oscillations of glacial activity and at least one brief interglacial period seem to be in evidence.

The climate of the Upper Carboniferous is unknown, since no sediments of that age seem to occur in Australia.

Severe glaciation on a continent-wide scale set in at the beginning of the Sakmarian, or only very slightly earlier, and lasted until the beginning of the Artinskian. All important glacial deposits of Australia are of that age.

The Artinskian was a period of marked amelioration of climate. Warm currents along the coast of Western Australia brought Tethyan faunas to more southern latitudes. Important coal measures were formed, although the return of local highland glaciations is indicated in north-eastern Australia in late Artinskian time. During the rest of Permian time Australia's climate, without being rigorous, was decidedly not warm and the thick coal seams of the Upper Coal Measure series were probably formed under cool to temperate conditions.

What little evidence is available for the Triassic suggests a warm climate during this period.

## Proceedings of the Commission for the International Geological Map of Africa

### REPORT OF A MEETING OF THE COMMISSION AT 2 P.M. ON WEDNESDAY, AUGUST 25TH

Dr. Dixey, President of the Association of the African Geological Surveys, was in the Chair.

#### REPORT OF THE ASSISTANT SECRETARY GENERAL.

The Assistant Secretary General of the Commission, M. F. Blondel, read his report as to progress of work on the Map to date. This report is attached hereunder.

The Chairman expressed his satisfaction with the progress made and thanked the Secretary General and his assistants for the work they had done. He said he felt sure that the work undertaken would soon be brought to a satisfactory end.

The Commission expressed agreement with the Chairman's words.

#### RENEWAL OF MEMBERSHIP OF THE COMMISSION.

The Chairman referred with deep regret to the death of Professor A. Lacroix, the eminent scientist and President of the Commission since its inception. He proposed that Professor A. Lacroix be succeeded by M. de Margerie, who was one of the initiators of the Map, and whose help had been



## COMMISSIONS

invaluable throughout. He was glad to announce that both the Vice-Presidents of the Commission, Sir Edward Bailey and Professor Fourmarier, were present at the Congress, and proposed that they both be re-elected to this office. The proposal was carried unanimously.

The Chairman proposed that the Assistant Secretary General of the Commission, M. F. Blondel, be elected Secretary General in place of M. de Margerie, who had now been elected President. The proposal was carried unanimously.

The Chairman said that membership of the Commission up till now had been by nomination. In view of the many changes which had taken place among those concerned, this method had been found to be impracticable. He proposed that from now on, membership of the Commission be restricted to:—

- (a) The Directors of the Geological Surveys of the various African territories.
- (b) Such Geologists as might be chosen for their particular knowledge of African problems.

*The proposal was carried unanimously.*

F. DIXEY,  
*Chairman.*

## REPORT OF THE ASSISTANT SECRETARY GENERAL

### GENERAL ORGANIZATION OF WORK.

The Secretary reminded members that the publication of the International Geological Map of Africa to the scale of one five millionth was decided upon at the Brussels Congress in 1922, under the directives of a commission presided over by M. A. Lacroix and of which the secretary general was M. de Margerie. Various difficulties delayed the commencement of the work for some considerable time and, to hasten its execution, the Bureau d'Etudes géologiques et minières coloniales was entrusted with the work in 1934. The director of this Bureau, M. F. Blondel, was appointed Assistant Secretary General of the Commission.

Preliminary exchanges of opinion then took place between the various African Geological Surveys to determine what documents should be used to establish the project of an index for the complete map, and to discuss the principal correlations which should be adopted. In view of the immensity of the African Continent and of the great difficulties encountered in its geological problems, it appeared preferable to carry out a work of international co-operation rather than a personal opus under a single signature. This method had the drawback of entailing very long delays in correspondence for adjustments of views between the various Surveys. Nevertheless it was considered to be the method most akin to the spirit of international co-operation represented by the Commission.

These exchanges of opinion showed the interest of close relations between the various African Geological Surveys. In order to materialize these relations it appeared opportune to create in 1937 an association of the African Geological Surveys, working as executive agents of the commission and whose secretaryship was entrusted to M. F. Blondel.

The adjustment of the correlations and of scientific research in connection with the map, as well as the actual execution of it, were carried out at the Bureau d'Etudes géologiques minières coloniales of Paris, and the Commission is greatly indebted to the particular help brought to this work by Mr. C. Kilian and to the zeal of M. G. Daumain. The organization and its decisions were ratified by the Commission during the Moscow Congress in 1937.

### PROGRESS OF WORK.

The general map of Africa was divided into nine sheets. The first Sheet (No. 1, North-west Corner) was published in May 1936, and presented at the Moscow Congress. Available stocks of this sheet having been destroyed during the war in 1943, the second edition was published in 1946.

Sheet No. 2 (Centre North) was published in 1948 (Contours determined in February 1940). Sheet No. 3 (North-east Corner) was published in 1947 (Contours finally determined in June 1939).

## PART I: GENERAL PROCEEDINGS

Sheet No. 4 (West) is now in print (August 1948). A printers' proof was presented to the Congress in London. Sheet No. 5 (Centre) and Sheet No. 9 (South-east Corner) were presented in draft form to the London Congress. They are ready for printing, subject to such changes in correlations as may result from the discussions at the present Congress. Sheet No. 7 (South-west Corner) has been reserved entirely free for the general descriptive index.

There only remains, therefore, the preparation of Sheet No. 8 (Centre South, South Africa) and Sheet No. 6 (East, East Africa). It is to be hoped that, subject to no unforeseen circumstances, the map will be entirely finished for the next Congress.

### FINANCIAL REPORT.

The above work was carried out, thanks to important contributions from France and French overseas territories on the one hand, and from Belgium and the Belgian Congo on the other.

More limited contributions were made by Uganda, Southern Rhodesia and Egypt prior to the war.

In order to bring this work to a successful conclusion, it is obvious that further contributions will be necessary, and it would be eminently desirable that such territories as had not yet contributed on any considerable scale should now carry their part of the burden.

F. BLONDEL,  
*Assistant Secretary General.*

### NOTE ON THE ASSOCIATION DES SERVICES GÉOLOGIQUES AFRICAINS

This body ranks as a Sub-Commission of the Commission for the International Geological Map of Africa. At its first meeting, held at 2 p.m. on Wednesday, August 25th, the following Officers were elected:—

<i>Honorary President</i>	...	...	E. B. Bailey (Great Britain)
<i>President</i>	...	...	F. Dixey (Great Britain)
<i>Secretary</i>	...	...	F. Blondel (France)

A full account of the series of open meetings organized during the Eighteenth Session by the Association des Services géologiques africains is given separately in Part XIV of the Report of the Session.

## Report of the Commission on Authors' Abstracts

### MEMBERSHIP OF THE RECONSTITUTED COMMISSION

<i>President</i>	...	...	M. Goldman (U.S.A.)
<i>Secretary</i>	...	...	F. Blondel (France)
<i>Members</i>	...	...	E. Alastrué (Spain)
			P. Eskola (Finland)
			J. Goguel (France)
			W. T. Gordon (Great Britain)
			M. Gortani (Italy)
			A. Hacquaert (Belgium)
			S. H. Houghton (Union of South Africa)
			N. Magnusson (Sweden)
			R. C. Moore (U.S.A.)
			F. Mouta (Portugal)
			N. Nygaard (Denmark)
			J. Royo y Gomez (Colombia)
			T. Vogt (Norway)
			To be suggested (U.S.S.R.)

## COMMISSIONS

IT was RESOLVED and AGREED:—

1. That, wherever possible, publishing authorities should insist, in every country, that the author of a paper be required to furnish an abstract of the paper submitted for publication.
2. That such abstract may be in the native language of the author, but that a translation of the abstract in at least one of the official languages of the Congress should, however, be provided.
3. That the Bureau of the Congress be asked to communicate with all participating countries to ensure that the objects of the Commission should be widely known.
4. That the Bureau of the International Geological Congress should be asked to explore the possibilities of collecting authors' abstracts in some central authority, and of publishing these abstracts, when obtained.

It was suggested that the Geological Survey in each country, or the authority responsible for official geological work therein, should act in assembling the authors' abstracts published in that country.

W. T. GORDON, *Chairman*.

### Report of the Commission on the Determination of Geological Age by Radiological Methods

Gentlemen:

As deputy for the late Alfred C. Lane (U.S.A.), former Chairman, I beg to report as follows:—

This Commission was set up at the Seventeenth Session at Moscow in 1937. Only the President, A. C. Lane, and the Vice-President, V. I. Vernadsky were appointed at that time. Dr. Vernadsky issued at Moscow invitations to the Geological Surveys of the various countries to appoint representatives. Uganda and the Gold Coast responded at that time, but before further representatives could be appointed, the war intervened, and the Commission never functioned.

In view of the existing restrictions on the international exchange of information in the general field of radioactivity, it is considered that the Commission be allowed to lapse at this time.

However, it is suggested that, if the international political situation permits, the Commission be reconstituted at the Nineteenth Session of the Congress.

At the meeting of Commissions held on the morning of the 26th August, 1948, the above report was presented and accepted by those present.

I might further add that the Committee on the Measurement of Geological Time of the National Research Council of the U.S.A. continues to collect and disseminate information in this field so far as conditions permit.

Respectfully submitted,

JOHN PUTNAM MARBLE.

### Report of Meetings concerning the Establishment of a Commission for the Preparation of a World Physiographic Province Map

More than 25 geologists, representing 15 nations, attended meetings to explore the possibilities of preparing an International Physiographic Map to complement the International Geologic Map. At the first meeting "a resolution was voted that the group approve the proposal for an International Physiographic Province Map and recommend that the Council of the Eighteenth Session of the International Geological Congress approve a Commission for this purpose."

Dr. Louis L. Ray of the United States was voted Chairman.

At a second meeting the following officers were elected:—

*First Vice-Chairman* ... A. A. Miller (Great Britain)

*Second Vice-Chairman* ... P. de Bethune (Belgium)

*Secretary* ... F. M. Fryxell (U.S.A.)

and their names are herewith submitted for the approval of the Council.



It is further proposed that the Commission have power to appoint members; that the officers of the Commission shall acquaint the suitable regional authorities or institutions of its aims and ask for recommendation of persons for membership and to work with the Commission.

It is believed that discussions for the standardization of methods, techniques and nomenclature, implemented by the work of the Commission, may be of such nature that it may provide valuable material for presentation at the next session of the Congress. The group therefore recommends to the Council that the Council inform the Organizing Committee for the next Session of the Congress of the desirability of providing for a Section of Geomorphology.

L. L. RAY,  
*Chairman.*

## Minutes of Meeting of the Temporary Commission on the Question of Meteorites held on Thursday, August 26th, 1948

The following members of the Temporary Commission were present:—

Walter Wahl (Finland)	F. A. Paneth (Great Britain)
J. P. Marble (U.S.A.)	F. H. Pough (U.S.A.)
J. Orcel (France)	L. J. Spencer (Great Britain)
W. Campbell Smith (Great Britain)	D. S. Korzhinsky (U.S.S.R.)
	representing V. V. Belousov.

together with:—

G. M. Cardoso (Spain)  
G. W. Gevers (S. Africa)

Professor W. Wahl, who was elected Chairman, asked the Members present to express their views as to the desirability of setting up a Commission for the international co-operation in the study of meteorites.

Dr. Marble thought this was certainly necessary, as the existing data were quite insufficient and some of them incorrect, leading to incorrect conclusions. It would, however, be impracticable to re-examine all the existing data. It would be very useful if the proposed commission could issue a statement pointing out the types of meteorites which should receive particular attention in future analyses (as some types had received more attention in the past than others), and give specific instances where work was particularly required, and work out a whole programme of meteoric analysis, so that the work can be carried out in a really scientific fashion and workers in allied fields can be supplied with reliable data.

Professor Wahl thought that the proposed Commission should not interfere with work already being carried out, but should supplement it.

Dr. Campbell Smith declared that, as work at the Museums was already in arrears, what was needed was more men who were qualified to carry out the analyses. Dr. Marble proposed that it should be suggested to geological departments of universities to take up this field as a theme for doctorate theses, under the supervision of members of the permanent staff.

Dr. Pough suggested that one or two places should specialize in the analysis of meteorites. Professor Wahl supported this suggestion, as this would enable small museums with insufficient facilities of their own to send their material to these centres to be analysed. Dr. Marble suggested that it be reported to the Congress that the Members present were of the opinion that a body of interested workers of an international character should be set up for the study of meteorites. He suggested also that the Members should continue their deliberations by correspondence.

Professor Wahl supplemented this proposal to the effect that such a Commission should be authorized to appoint an executive body of workers actually engaged in this field.

After a general discussion it was agreed to propose to the Council that the members of the Temporary Commission, supplemented by Dr. Michel of Vienna, Professor Wijkman of Stockholm,

## COMMISSIONS

Professor Zavaritsky and Professor Krynov of the U.S.S.R., Dr. Foshag and Dr. Perry of the U.S.A., should be appointed by the Council of the International Geological Congress to form a Permanent Commission on Meteorites, and Dr. Cardoso declared that the interesting collection of the Natural History Museum of Madrid would be at the disposal of such a Commission.

W. WAHL, *Chairman*.

### REPORT OF THE TEMPORARY COMMISSION ON THE QUESTION OF METEORITES

1. After discussion it was agreed that the Temporary Commission should propose to the General Council that a Permanent Commission on Meteorites should be appointed. This Commission should be authorized to appoint a small Executive Committee.

2. The Temporary Commission suggests that the members of the Temporary Commission as follows:—

Walter Wahl (Finland)  
J. P. Marble (U.S.A.)  
J. Orsel (France)  
W. Campbell Smith (Great Britain)  
F. A. Paneth (Great Britain)  
F. H. Pough (U.S.A.)  
L. J. Spencer (Great Britain)  
D. S. Korzhinsky (U.S.S.R.)

together with:—

G. M. Cardoso (Spain)  
G. W. Gevers (South Africa)  
H. Michel (Austria)  
F. E. Wickman (Sweden)  
A. N. Zavaritsky (U.S.S.R.)  
— Krynov (U.S.S.R.)  
W. Foshag (U.S.A.)  
E. Perry (U.S.A.)

should be appointed members of the Permanent Commission on Meteorites.

W. WAHL, *Chairman*.

### Report of the Temporary Commission on the Pliocene-Pleistocene Boundary, appointed 26th August, 1948

The following served as members of the Commission:—

Kirk Bryan (co-opted) (U.S.A.)	K. P. Oakley (Great Britain)
A. T. Hopwood (Great Britain)	L. L. Ray (co-opted) (U.S.A.)
W. B. R. King (Great Britain)	I. M. van der Vlerk (Netherlands)
L. S. B. Leakey (Kenya)	D. N. Wadia (India)
C. I. Migliorini (Italy)	D. M. S. Watson (Great Britain)
K. Milthers (co-opted) (Denmark)	E. J. Wayland (Bechuanaland)
Hallam L. Movius, Jr. (U.S.A.)	F. E. Zeuner (Great Britain)
G. Dubois (France)	

1. The Commission considers that it is necessary to select a type-area where the Pliocene-Pleistocene (Tertiary-Quaternary) boundary can be drawn in accordance with stratigraphical principles.

## PART I: GENERAL PROCEEDINGS

2. The Commission considers that the Pliocene-Pleistocene boundary should be based on changes in marine faunas, since this is the classic method of grouping fossiliferous strata. The classic area of marine sedimentation in Italy is regarded as the area where this principle can be implemented best. It is here too that terrestrial equivalents of the marine faunas under consideration can be determined.

3. The Commission recommends that, in order to eliminate existing ambiguities, the Lower Pleistocene should include as its basal member in the type area the Calabrian formation (marine) together with its terrestrial equivalent the Villafranchian.

4. The Commission notes that according to evidence given this usage would place the boundary at the horizon of the first indications of climatic deterioration in the Italian Neogene succession.

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Approved unanimously at a meeting of the Commission held on August 28th, 1948, and also by an almost complete majority at a meeting of Section H attended by about 150 members.

W. B. R. KING, *Chairman*.

K. P. OAKLEY, *Secretary*.



## INTERNATIONAL PALEONTOLOGICAL UNION

### Rapport présenté au Conseil du dix-huitième Congrès géologique international, Séance du 30 Août, 1948

L'UNION paléontologique internationale, réunie à Londres à l'occasion du XVIII<sup>e</sup> Congrès géologique international, a pu travailler avec fruit et a tenu, dans le cadre de ce Congrès, trois séances de son Conseil et trois séances plénières, au cours desquelles ont été faites 17 communications, se rapportant principalement aux questions générales de la bibliographie et de la documentation paléontologiques, et à des questions plus particulières, telles que la micropaléontologie et la nomenclature.

Ce résultat a pu être obtenu grâce, d'une part, à l'excellente préparation de cette session, faite par le Comité local de l'Union paléontologique internationale, sous la présidence du Professeur A. Morley Davies, avec l'active collaboration du Dr. C. J. Stubblefield, et d'autre part, grâce à l'aide si efficace donnée par le Comité général d'Organisation du XVIII<sup>e</sup> Congrès. A ces deux organismes, l'Union paléontologique internationale exprime sa profonde gratitude.

Elle exprime également sa reconnaissance au Professeur F. Howell, qui a assumé avec dévouement et efficacité la permanence de son secrétariat, pendant la longue et difficile période qui s'est écoulée depuis le précédent Congrès.

Comme je l'ai annoncé à la précédente réunion de ce Conseil, le Conseil de l'Union paléontologique internationale a décidé que le Dr. C. J. Stubblefield serait son observateur officiel et son délégué permanent, pour toute négociation, initiative ou décision, qu'il y aurait lieu de réaliser, en vue d'établir la coopération que l'Union souhaite avec l'UNESCO, pendant la période séparant cette XVIII<sup>e</sup> session du Congrès et la suivante.

Enfin, j'informe le Conseil que l'Union paléontologique internationale a organisé la composition de ses Commissions spéciales et qu'elle a constitué son nouveau bureau, dont les pouvoirs commencent dès la clôture de l'actuelle session. La liste détaillée en paraîtra dans les Comptes rendus du Congrès. Le Professeur A. Morley Davies a été élu Président de l'Union et le Professeur H. E. Vokes, Secrétaire.

*Le Président, P. PRUVOST.*

# THE STRUCTURAL HISTORY OF ENGLAND AND WALES\*

By Professor O. T. JONES, F.R.S.

Special Address to the General Assembly in the Lecture Theatre of the Royal Geographical Society at 8-30 p.m. on Thursday, August 26th, 1948

To parody a very famous saying: "Nowhere is so much geology found in such a small space as in the British Isles." In spite of intensive work for over a century, important discoveries can still be made, as participants in certain excursions will find out.

The geology has largely been mapped on the scale of 6 inches to the mile or 1 in 10,600, and some on the scale of 1 in 2,500 or 25 inches to the mile. With so much ground to cover I can obviously only indicate the main lines of the structural history of England and Wales, and I am thankful that Scotland is to be dealt with by Sir Edward Bailey than whom no one is more fitted for the task.

The dominant physical features and their great diversity are due to the numerous and varied kinds of rocks which are found in the area. The greatest elevations range from mountains of over 3,000 feet in both the North of England and the North of Wales; while at the other extreme there are large level stretches such as the Fenland of East Anglia, parts of which, like much of Holland, lie several feet below the mean level of the sea, and if not protected by dikes would be submerged under many feet of salt water.

The greatest heights are found in the Lake District, and in Wales, in both instances on volcanic rocks of Lower Palaeozoic age.

Next to them in order of height we have elevated tracts mainly on Carboniferous rocks in the north-south trending Pennine Range; at the northern end the Cheviot Hills are due to an augite-granite intruded into Devonian lavas. Another tract, the Brecon Beacons in South Wales, forms the summit of a magnificent escarpment carved out of Old Red Sandstones; while in the south-west of England high points are on large outcrops of granite intruded into Carboniferous and Devonian sediments. In the east and south-east of England the high land areas lie either on the outcrop of the Jurassic rocks from the Cleveland Hills in Yorkshire to the Cotswolds in Gloucestershire, or on a more or less parallel outcrop of Chalk from the Wolds in Yorkshire and Lincolnshire to the Chilterns near the Thames Valley and on the north and south Downs on each side of the Weald.

The broad geological subdivisions of the rocks can be seen on any small scale geological map, such as that prepared for the Congress by H.M. Geological Survey; I may point out that much exciting geology can be seen in the field within an area less than that covered by the head of a pin on this map. My task is rendered much simpler through the production, also by the Geological Survey, of a series of excellent guides to various regions which between them cover the country. The Survey Officers responsible for these guides have put so much of the geology in a readily understandable pictorial form that I conceive the best service I can render is, as it were, to present a general guide to these Regional Guides.

I interpret structure as meaning not only the more spectacular earth movements, usually upward, which have affected the country at various periods, but also the less spectacular but no less important slow movements, usually downwards, which went on during the formation of the great series of sedimentary rocks found in the area.

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\* Grateful acknowledgment is made to the Controller of H.M. Stationery Office, The Clarendon Press, the Editor of the Geological Magazine, the Council of the Geological Society of London, the Council of the Royal Society of Edinburgh, and the akademische Verlagsgesellschaft, Leipzig, for permission to reproduce illustrations to the following addresses.

Let us then start with the foundation of the good old Precambrian portmanteau, which is as full of imperfectly sorted rocks as in most other parts of the world. Fortunately for me, we now know in most cases in England and Wales that they are Precambrian, and I am not therefore bothered by the possibilities that they may be Eocambrian or a downward continuation of the Cambrian or respectable Lower Palaeozoic rocks, masquerading in an "old-look" dress.

## PRECAMBRIAN.

The structural history of the Precambrian was obviously very varied and except incidentally I cannot deal with it in the time. We find these rocks best developed in the island of Anglesey, but they occur also in parts of the North Wales peninsula, or the South Wales peninsula round the famous city of St. Davids; again in the Welsh Borderland and in several places in the Midland region as far east as Charnwood Forest in Leicestershire. They have been proved in borings under Mesozoic rocks even as far as North Creake, Norfolk.

In the south-west, the schists which form Start Point and those of the Lizard Peninsula associated with serpentines, are probably Precambrian, though the Lizard rocks may be younger.

In Anglesey an old series of gneisses was succeeded unconformably by a varied bedded series possibly some 20,000 feet (7,000 m.) thick and both were intruded later by granites. As interpreted by Dr. Greenly the rocks have been folded into gigantic recumbent folds subsequently refolded and corrugated (see Fig. 1). The principle used in unravelling the various series is that of conjunction and composition. Certain pairs of the series are constantly found next to one another, and it was found that one of a pair contained pebbles derived from the other. That gave the order of age of the members

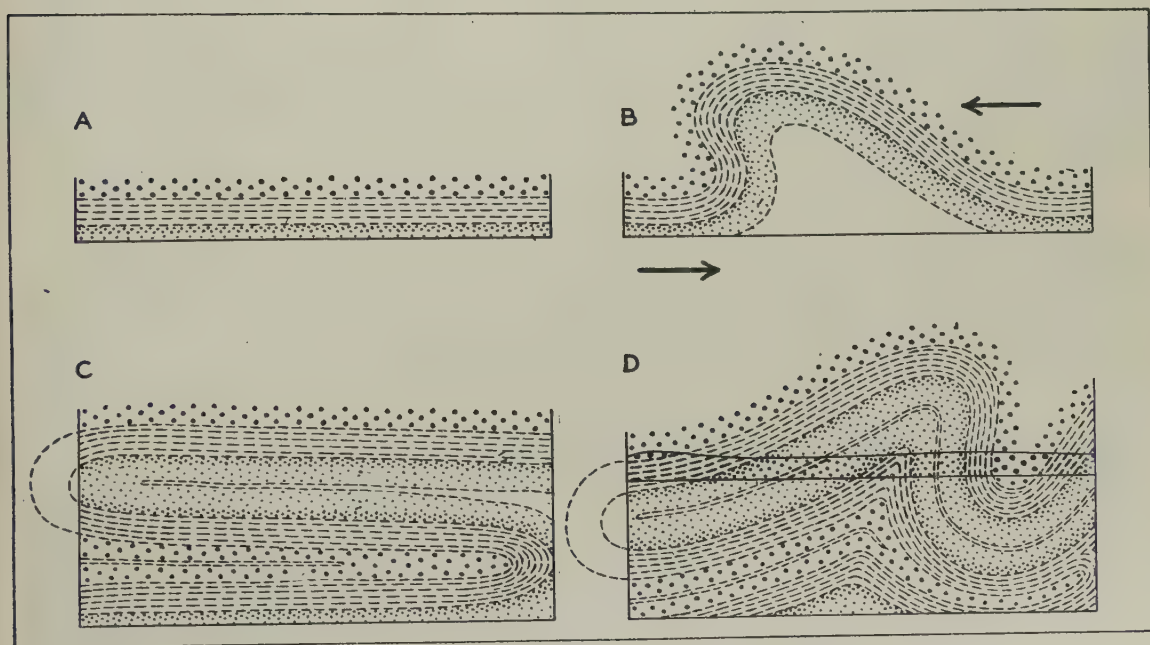


FIG. 1.—*Diagrams illustrating the Development of Plicated Overfolds.*

The diagrammatic sections show the development of an asymmetrical fold (B) passing into a recumbent fold (C), which is in turn plicated (D). The arrows in (B) show the directions of relative movement. In (D) the narrow area with darker shading is essentially a simplified representation of the folding occurring between Holyhead Mountain and Cymyran Bay.

(After Bernard Smith and T. Neville George, "British Regional Geology: North Wales," *Geol. Surv.*, 2nd Edition, 1948, p. 12.)



of that pair, and from this other pairs could be assigned to their correct order of age in spite of the great complexity caused by the intense movements which also occurred in Precambrian times. One of the bedded groups consists of pillow lavas also found on the mainland in the Lleyn Peninsula; there they adjoin Lower Ordovician pillow lavas associated with shales which are not even cleaved. The striking contrast in the physical condition of the two adjoining rocks tells forcibly of the much greater antiquity of the Lleyn and Anglesey rocks.

In other parts of the country the Precambrian rocks consist of acid lavas and ashes (N. Wales, Shropshire), intermediate to acid ashes and soda granite (S. Wales), dioritic gneisses (Malvern and Johnston, S. Wales), ashy sedimentary rocks with subacid intrusive rocks (Leicestershire and Warwickshire), also a great thickness of sedimentary rocks (Longmynd, Fig. 2). They are in general exposed at the cores of anticlinal axes of various ages.

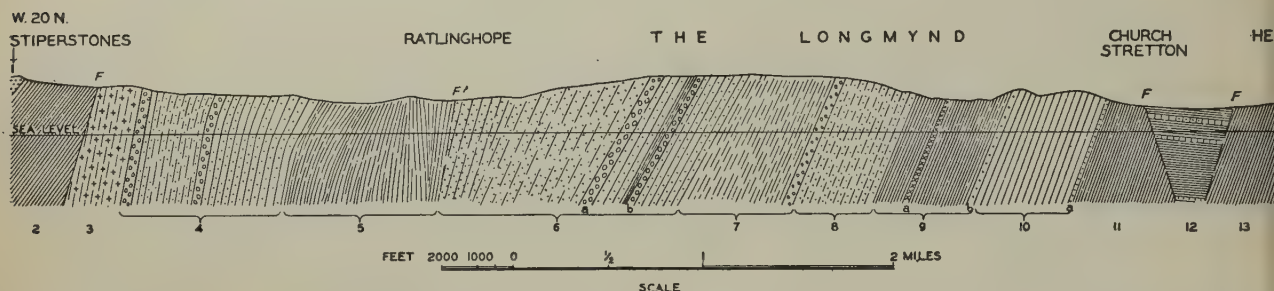


FIG. 2.—Section from the Stiperstones, across the Longmynd, to Helmeth Hill.

1, Stiperstones Quartzite; 2, Cambrian (Shinerton) Shales; 3, Western Uriconian; 4, Oakwood Group; 5, Bridges Group; 6, Bayston Group, (a) Stanbatch Conglomerate, (b) Darnford Conglomerate; 7, Portway Group; 8, Lightspout Group; 9, Synalds Group, (a) Batch Volcanics, (b) Cardingmill Grits; 10, Burway Group, (a) Buxton Rock; 11, Brockhurst Shales; 12, Silurian; 13, Watling Shales; 14, Eastern Uriconian. (Eastern part based upon the work of C. Lapworth and E. S. Cobbold.) (After R. W. Pocock and T. H. Whitehead, "British Regional Geology: The Welsh Borderland," *Geol. Surv.*, 2nd Edition, 1948, p. 22.)

#### CAMBRIAN.

The systematic structural history of the area begins with the Cambrian, and we see almost from its beginning a division of England and Wales into two regions of contrasted behaviour. So far as surface outcrops go, Cambrian rocks are restricted to Wales and the Midlands.

The Cambrian rocks of Wales consist of anything between 10,000 and 16,000 feet (3,000 to 5,000 m.) of sandstones and shales: many of the earlier rocks are red as if formed under semi-arid conditions. The greatest thickness occurs in North Wales in the great anticlinal upfold called the Harlech Dome, but the same rock types occur also in South Wales near St. Davids.

In the Midlands, the thickness of the Cambrian does not exceed 4,000 feet (1,300 m.); the rocks are finer grained than in Wales and few red beds occur; the line of transition between the two different facies lies somewhere near the Longmynds. Just east of the Longmynds there are several breaks in the succession marking interruptions in sedimentation on a belt, which divides the stable or slowly sinking region on the east from the more rapidly sinking region on the west which belongs to the geosyncline. This great Lower Palaeozoic or Caledonian geosyncline was thus very sharply defined southeastwards early in Cambrian times; since no Cambrian rocks are known in Anglesey a north-western limit is thus also defined.

#### ORDOVICIAN.

The Ordovician System succeeds the Cambrian more or less conformably, but there are in places, particularly in N. Wales, and near St. Davids, evidences of some movement between the two

formations. Eastwards the system is not known beyond the Welsh Borders and it was not apparently deposited on the stable platform, or if it was, it has been eroded away.

It occurs, however, in force in Anglesey where Cambrian is now absent, spreading well beyond the limits of that System, and is developed in great strength in the Lake District. In Wales and the Borders some 2,000 to 5,000 feet (700 to 1,700 m.), mainly of shales, were added to the geosyncline and it is noteworthy that much more was laid down near the eastern margin of the geosyncline than elsewhere.

In the Lake District, two formations—the Skiddaw slates and the following Borrowdale volcanic series—are of very great thickness, but no one has yet succeeded in finding out how great and the base of the Skiddaw slates is not exposed. We may reckon, however, upon a very substantial contribution to the geosyncline during the Ordovician.

Volcanic rocks are characteristic and widespread. In some areas, ashes of intermediate or acid composition (Cader Idris, Arenig, Snowdon, Lake District), in others, spilitic rocks are well developed (Fishguard, Builth, Cader Idris). The latter rocks appear to be, in general, associated with downwarping.

In places along the eastern borders of the Welsh Lower Palaeozoic outcrops, important movements occurred which have not been recognized in other parts of Britain. These began in late Ordovician times and were completed early in the Silurian, and it is of considerable interest that they correspond closely in age with the Taconic movements in the State of New York.

## SILURIAN.

During the Silurian the geosyncline continued to subside and to fill. The contrast between the stable platform and the geosynclinal tract was again sharply defined though a veneer of Silurian sediments spread widely eastward over the platform. The contrasted behaviour of the two regions caused also a marked difference between the faunas—a shelly fauna on the platform and a graptolitic fauna in the geosyncline. The progress of downwarping in the geosyncline can be traced very clearly by making use of successive bands of dark graptolitiforous shales the course of which has been mapped with great accuracy throughout Wales. In parts of the geosyncline (Denbighshire, N. Wales and Radnorshire, Central Wales) we see developments of hundreds of feet of slumped beds which slid down the slopes of the sea floor, mainly in the Lower Ludlow and Upper Wenlock periods respectively.

In the Lake District, thousands of feet of shales and sandstones were piled on top of the Ordovician. It is interesting that both in Wales and the Lake District, sedimentation was accelerated towards the close of the Silurian—the Ludlow in N. Wales probably well exceeded 7,000 feet (2,300 m.) but in the Lake District these rocks are believed to be at least 12,000 feet thick (4,000 m.). In Wales the geosyncline is estimated to have been depressed, in places to about 30,000 to 35,000 feet (10,000 to 12,000 m.) before the end of the Silurian, and in the Lake District by at least as much. Indeed if some estimates of thicknesses of the Skiddaw slates and Borrowdales are accepted and to these are added those of the Silurian formations, we are faced with a possible depression of the pre-Ordovician floor of the Lake District by between 34,000 and 46,000 feet (11,000 - 15,000 m.). The latter figure is a good deal more than the thickness (11 kms.) assigned by Dr. Jeffreys to the granitic crust.

The Lower Palaeozoic geosyncline began to give way towards the close of the Silurian, ultimately resulting in great compression of the more or less yielding Cambrian to Silurian sediments. These were, in general, corrugated into concertina folds, the trends of which appear to have been governed by subsurface conditions. Among these, the most important appears to have been the position of the margin of the geosyncline which divided the region of active depression from the stable platform to the east, and, in general, the trends of the folds conform to those of the margin and the axial regions of the geosyncline. In places also the rocks were intensely cleaved to roofing slates particularly in N. Wales.

Since the sediments of the geosyncline were laid down upon a foundation of more rigid rocks of various Precambrian ages, it would be of interest to discover whether this foundation was corrugated like the overlying rocks, or was crushed together so as to allow of the corrugations of their cover.

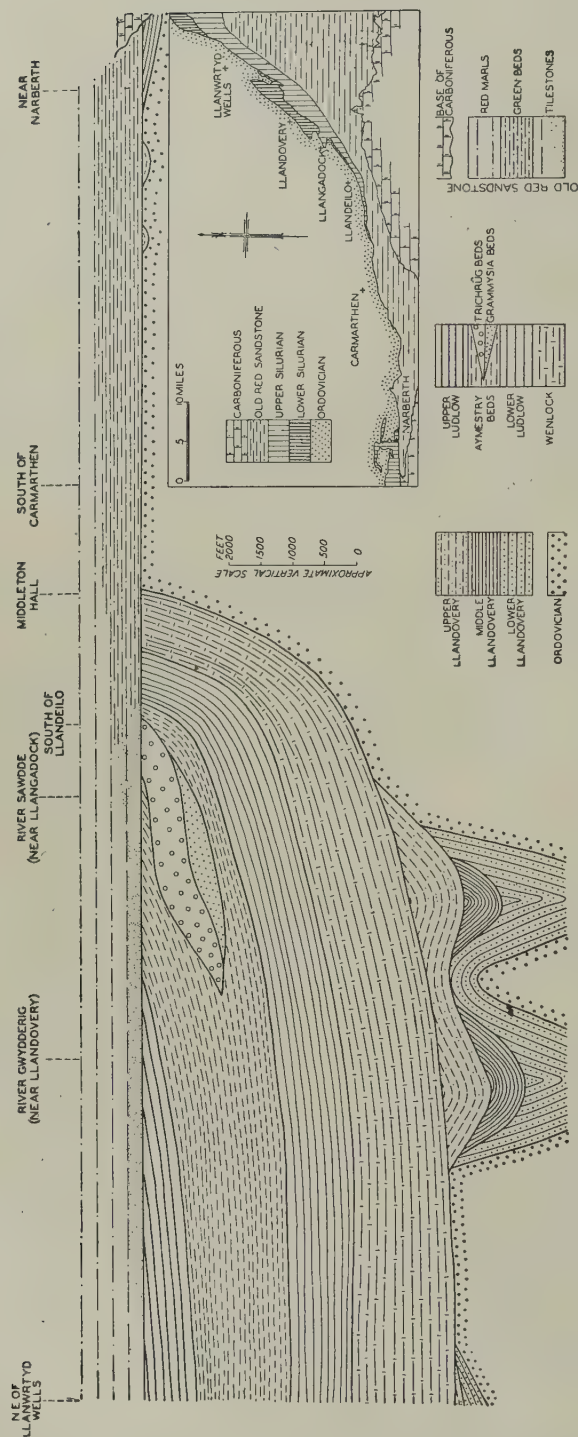


FIG. 3.—Diagrammatic Section showing the Succession of Silurian and Lowest Old Red Sandstone Strata along the South-Eastern Flank of the Towy Anticline.

(After J. Pringle and T. Neville George, "British Regional Geology: South Wales," 2nd Edition, 1948, p. 40.)



This last appears to be the correct answer since the lowest Cambrian beds of the Nantlle slate district are traversed by a close-set system of parallel steep fractures which appear to pass upwards into folds. They indicate that considerable crushing of the underlying Precambrian floor must have occurred.

Along the eastern borders we see clear indications that the conditions of the Lower Palaeozoic deposition were about to change before the end of the Silurian, for at the close of the Ludlow, grey shales gave way to green muds followed by red muds which foreshadowed the succeeding Old Red Sandstone conditions (Fig. 3). There is evidence in that formation that marine conditions in a very restricted sense continued for some thousands of feet after the close of the Ludlow. There is little doubt, however, that during this time although sedimentation continued on the eastern flank other parts of the geosyncline farther northwest were already beginning to rise and to be undergoing subaerial denudation.

#### OLD RED SANDSTONE AND CARBONIFEROUS.

The Old Red Sandstone deposits mark the beginning of another long period of sedimentation in the Upper Palaeozoic and of the initiation of another great geosyncline over the southern part of England and Wales which may be termed the Armorican or Variscan geosyncline. In spite of their quite different trends the northeast-southwest Caledonian geosyncline passes over continuously into the east-west Armorican geosyncline in the region of the Welsh Borders and South Wales.

It is convenient, therefore, to consider at this point the growth of this southern geosyncline. The Devonian System is, as has long been known, developed in two distinct facies—that of the Old Red Sandstone in South Wales and the Welsh Borders which is probably in the main lacustrine, or at times estuarine, and the marine facies of Devon and Cornwall. The rocks of N. Devon though containing marine fossils are in places allied lithologically to the Old Red Sandstone, but those of South Devon are typical marine grey shales, sandstones and limestones. There may even be a third facies of grey shales in Cornwall and South Devon which is of estuarine or deltaic origin. The rocks were formerly assigned to the Ordovician but Miss Hendriks later discovered in places in them remains of plants probably of Middle Devonian age, and it is now considered likely that most, if not all, of these rocks represent a facies of the Devonian different from the admitted rocks of that age to the north. It is not improbable that the various rocks of S. Cornwall as well as the serpentines of the Lizard have been piled one above the other along great overthrusts from the south.

Undoubtedly a great thickness of sediments was laid down in the southwest in the Devonian period, but it is impossible to hazard a guess at how much and moreover the base of the Devonian is not known. The succeeding Carboniferous is represented in part by shales of *Cleistopora* to *Zaphrentis* zone age in a part of the Pilton Beds; but the succeeding part of the Carboniferous either follows these unconformably or is developed as the Culm facies of Germany. Higher beds in the succession have yielded goniatites indicating an upper Carboniferous or Millstone Grit age, while non-marine lamellibranchs and plants prove that although coal seams are not present, the lower part of the productive coal measures found in other parts of the country is represented. It is unfortunately impossible to make even an approximate estimate of the thickness of Carboniferous shales and sandstones which were deposited in the southern part of the Armorican geosyncline but it is probably to be reckoned in tens of thousands of feet or many thousands of metres. North of the Bristol Channel the Old Red Sandstone consisting mainly of red with some green sandstones and marls varies greatly in thickness from place to place; in one part of Pembrokeshire, one subdivision alone (the Coshaston beds) is 10,000 feet (3,000 m.) thick, but in general we may assume an average thickness of about 8,000 feet. The Lower Carboniferous also varies somewhat, but we adopt an average of 4,000 feet (1,300 m.), and for the Millstone Grit about 1,500 feet (500 m.). Next come the Coal Measures of the South Wales coalfield; the average thickness of those measures now preserved from denudation is about 7,000 feet (2,300 m.) but as we shall see, there are now two good reasons for believing that about twice this thickness may have been present at the close of Carboniferous sedimentation in the area. The first reason for this belief is that, unlike most British coalfields, the highest rocks preserved in the coalfield are typical productive coal-bearing strata which were formed under conditions similar

to those of the underlying measures and there is nowhere any suggestion in the type of sediment then laid down of an approaching change or end to the sedimentation in that part of the geosyncline. The second reason is based on an important discovery recently made by Dr. Trotter of H.M. Geological Survey, that the rate of change of the volatile content of coal seams varies with depth in a systematic manner in the South Wales coalfield. Analyses of about 300 samples by Strahan and Pollard published many years ago by the Geological Survey combined with the application of Dr. Trotter's rule makes it possible to refer volatiles over a large area to one seam whether they have been determined in that seam or in a higher or a lower seam. It is thus possible to construct an isovolatile or isovol map for that seam. The result is a most remarkable picture. The higher volatiles from 30 to 35 per cent follow closely on the east and south the existing margin of the coal measures and lower volatiles follow them in concentric courses, the coals finally attaining their highest rank in the anthracite area on the north-west. More recently, a large number of new analyses have been obtained by the Fuel Research Board and from them officers of that Board have also constructed an isovol map based in the main and by good fortune upon the same seam that I selected for plotting the Strahan-Pollard analyses. This map differs only in minor details from that based upon the older analyses.

In view of the extraordinary regularity of the behaviour of these isovolts, there can only be one explanation, viz., the depth to which the coals were buried. If it be assumed that the rule which applies to volatiles ranging between 36 per cent and 10 per cent may also be applied approximately to higher and lower volatiles, we can obtain some idea of the actual depth of burial. It is clear however that the so-called constant in Dr. Trotter's rule itself depends upon the volatile content of the seams and that the rate of change is more rapid than the average at higher volatiles and less rapid at lower volatiles. With this modification it is possible to construct a graph representing the change with depth of coal-forming material starting perhaps from the composition of a peat and increasing in rank up to that of anthracite. The importance of this discovery can be readily appreciated. It enables us to make an estimate from the volatile content alone of a coal seam of the thickness of measures which once overlay that seam or, in other words, the depth to which that seam was depressed since its material was accumulated at or near the surface of the ground. The thicknesses obtained from the volatile contents of successive seams record in great detail the progress of sedimentation. It must, however, be borne in mind that (1) cannel coals obey a different law which has yet to be investigated and (2) the thicknesses are of fully consolidated rocks; before their compaction the depth of the column of sediment of given present thickness was considerably greater than it now is.

From the graph it can be deduced that the western end of the coalfield where anthracite is now mined was at one time buried beneath at least 13,000 to 14,000 feet (4,000 to 4,300 m.), measured as compacted rock, or probably about 18,000 feet (6,000 m.) of original mud-and-water sediments. The differences between thickness of original cover as estimated from the Strahan-Pollard analyses and from the more recent analyses by the Fuel Research Board are insignificant; the greatest discrepancy is less than 1,000 feet.

It may be estimated, therefore, that the thickness of sediments laid down in the S. Wales coalfield part of the Armorican geosyncline including about 2,000 feet of Silurian rocks was about 32,000 to 34,000 feet (10,000 to 11,000 m.); it was therefore comparable with that which was laid down in the Lower Palaeozoic or Caledonian geosyncline to the north-west.

It is not improbable that these thicknesses were greatly exceeded in the Devon-Cornish peninsula and that the deepest part of the geosyncline was found there.

When we turn from the south-west of England and South Wales to the North of England, or even North Wales, the contrast between the structural history of those regions is remarkable. Old Red Sandstone is absent, and instead of a passage from the Lower Palaeozoic to the Upper Palaeozoic sedimentation which is found in parts of the southern region we find a great unconformity where almost horizontal well-bedded Carboniferous Limestones rest on an evenly eroded surface of Ordovician and Silurian rocks which had been heavily folded and in places cleaved.



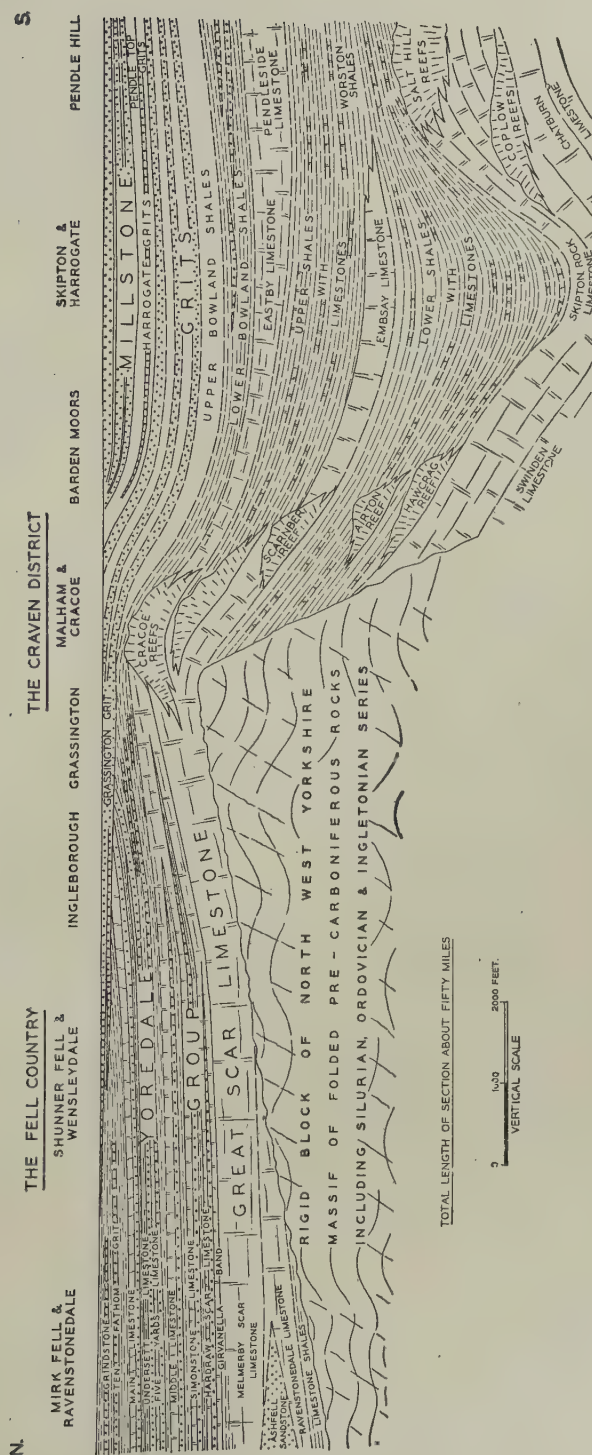


FIG. 4.—Geological section showing the succession and relations of the Carboniferous Limestone Series, Yoredale Group, Bowland Shales, and Millstone Grit in the Fell Country and the Craven District.

(After R. G. S. Hudson: from D. A. Wray, "British Regional Geology: The Pennines and Adjacent Areas," *Geol. Surv.*, 2nd Edition, 1948, p. 23.)



It is immediately obvious that a great period of subaerial erosion followed by marine planation had occurred in the northern region between the Caledonian folding at the close of the Silurian and the onset of Carboniferous sedimentation. During that period of folding and erosion Old Red Sandstone or Devonian and early Carboniferous sediments were being accumulated in the southern region.

Looking at this northern region more closely, perhaps its most striking structural feature is the sharp separation of the region into two areas of contrasted behaviour. The boundary between these is approximately defined at present by a belt of faults called the Craven Faults. The ground to the north may be referred to as the Yoredale area, while that to the south or southwest of it may be called the Bowland area. The contrast indicated by these two regions has long been known; it is comparable in many respects to that between the stable platform area of the Midlands during the Lower Palaeozoic and the geosyncline of Wales.

North of the Craven Faults, massive Carboniferous limestone, known as the Great Scar Limestone, is succeeded by alternations of sandstones and shales in which occur a series of thin limestones. These are the well known Yoredale beds which are characteristic of the northern Pennines and of the Yorkshire dales on the east flank of the range. The base of the Great Scar Limestone is not, however, the base of the Carboniferous system where fully developed. Near the base of the Yoredale, reef knolls are developed in the *Dibunophyllum* zone.

Southwest of the Craven Faults, lower Carboniferous limestones belonging to the *Zaphrentis* to *Seminula* zones occur in the Clitheroe district; though their base is not seen, they are at least 2,500 feet (800 m.) thick. They are followed by about an equal thickness of shales called the Worston shales which represent the whole of the upper half of the Carboniferous Limestone (*Dibunophyllum* zone) and at the top include a limestone which has been compared with one of the Yoredale limestones. In the limestones of the Clitheroe area there are developments of knoll reefs at two levels, viz. in the *Syringothyris* or *Caninia* zone and in the *Seminula* zone.

From the total thickness of deposits below the Millstone Grit, it is obvious that much greater depression occurred in the Bowland than in the Yoredale area (Fig. 4). The rigid block or foundation of the limestone in north-west Yorkshire has been known for a long time. Until a few years ago most geologists would have inferred that the Yoredale type extended far to the east, but a boring put down to test for oil through the Cleveland Hills Jurassic rocks proved quite otherwise. Below the Millstone Grit there were only a few limestones, but these did not compare badly with the Yoredales; below these, however, thousands of feet of shales with only very thin limestones were penetrated and the borehole finished in these at a depth of 6,283 feet, having passed through nearly 4,000 feet of Lower Carboniferous rocks containing only about 300 feet of limestones, the rest being mainly shales.

It is obvious that these lower shales are the equivalents of the Worston shales that overlie the Clitheroe reef knolls and thus the Yoredale and the Bowland development occur in one succession. It is not unlikely that the Lower Carboniferous attained there a thickness of 6,000 to 7,000 feet (2,000 to 2,300 m.). This great shale facies must be connected across the site of the Pennines; the northern edge of the connecting channel is obviously defined by the Craven Faults; the southern edge may be defined by the northern edge of the Derbyshire limestone massif 40 to 50 miles to the south where there are also some reef knolls in beds of the *Dibunophyllum* zone, comparing roughly with those of the Craven area (Fig. 5).

The northern Millstone Grit is a variable formation which reached its greatest thickness of about 3,000 feet in Derbyshire and Lancashire. The succeeding coal measures are at their thickest in Lancashire, where about 7,000 feet of Productive measures were laid down, including Lower, Middle and Upper coal measures. Judging by the volatile content of the lowest seam in the Middle coal measures one would infer that it had been buried under more than 5,000 feet of fully compacted measures. The actual cover may have reached 7,000 to 8,000 feet (2,300 to 2,600 m.) of coal measure sediment. The thickness now present is about 4,800 feet (1,500 m.) of productive measures but there is, in addition, a considerable thickness of barren measures called the Ardwick Series at the top.

Since this group is unconformable on the productive measures, its contribution to the cover on the seams is uncertain.

The cover on the seams in the York-Derby-Notts. field appears to have been somewhat less at about 4,500 feet (1,400 m.). The thickness now present below the Barren measures varies from 3,000 to 4,000 feet, so that presumably several hundred feet of cover were removed from that field (see Fig. 6).

In both these areas the uppermost or barren measures show that the characteristic coal measures sedimentation had come to an end and was replaced by lagoonal or semi-continental types of deposits

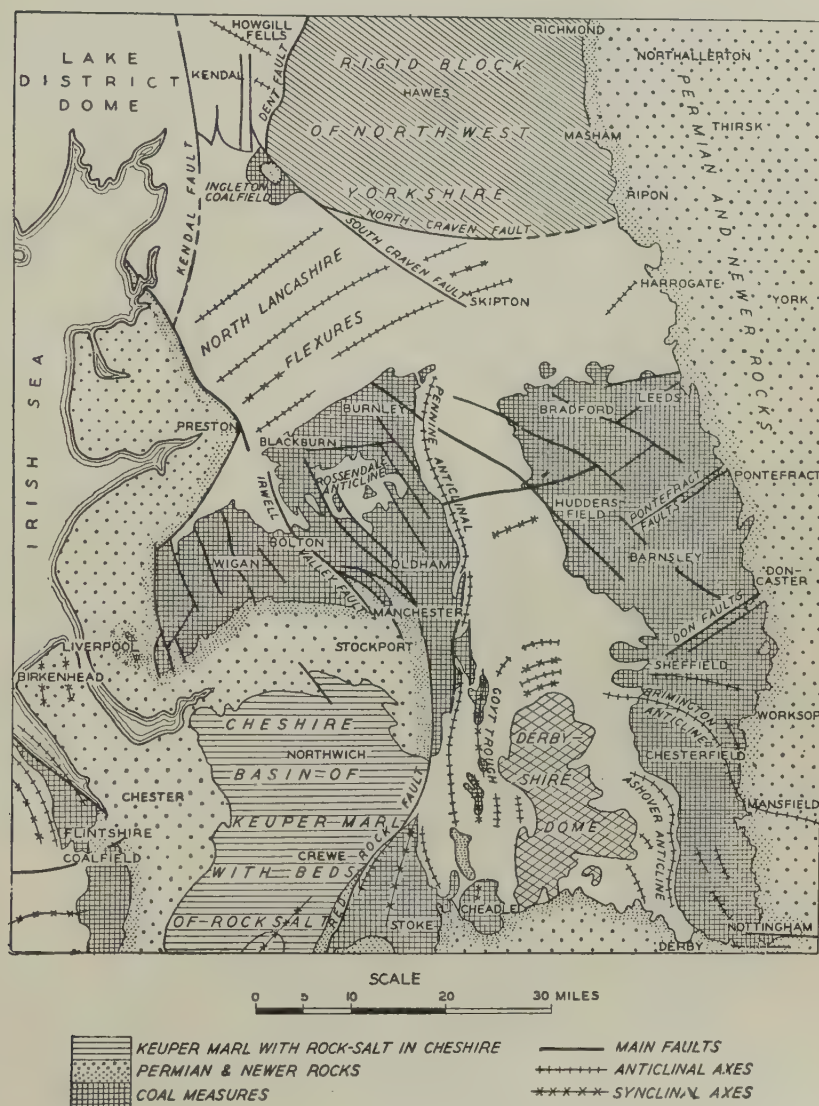


FIG. 5.—Sketch-map showing the main tectonic features in the Pennines and adjacent areas.

The areas occupied by the Millstone Grit and older rocks are unshaded, with the exception of the Rigid Block of North-west Yorkshire and the Derbyshire Dome. The latter consists of Carboniferous Limestone.

(After D. A. Wray, "British Regional Geology: The Pennines and Adjacent Areas," *Geol. Surv.*, 2nd Edition, 1948, p. 77.)





The events at this stage of the close of Carboniferous sedimentation are, however, more clearly displayed farther south in North Staffordshire and other Midland coalfields. There we have clear indications of the approach to continental conditions in the Etruria Marl and the Keele beds which are both red mudstones; but still more convincing is the succession in the Warwickshire Coalfield where the Keele beds are succeeded by the Enville Series of red beds containing conglomerates and breccias. These are considered to have been formed under arid conditions not unlike those of the succeeding New Red Sandstone and in Warwickshire reached a thickness of 3,500 feet.

The rocks which are referred on the basis of their lamellibranch fauna to the Upper Coal Measures vary considerably in different parts of the country, and it is obvious that movements of uplift leading to unconformities had already affected parts of the Carboniferous basins before the close of the Coal Measures. Generally speaking, these breaks are more important near the edges of the basins and have no more than local significance; it would be a disservice to give each of them names as is sometimes done. One of the best examples is the so-called Symon Fault in Shropshire where the Upper Coal Measures rest with marked angular discordance upon various lower beds (Fig. 7); a similar unconformity occurs at the base of the same measures in the Forest of Dean coalfield (Fig. 8).

The lamellibranch zones reveal that in South Wales normal coal measures sedimentation was proceeding there during the period of the *Anthraconauta phillipsii* and *A. tenuis* zones at the same time that red beds were forming in the Midlands and repeated breaks were developing in the succession. It is therefore to be expected that similar phenomena later brought sedimentation in South Wales to a close ending perhaps with the formation of red measures. The total thickness of rocks that were eventually laid down in that coalfield is therefore unknown but, as shown already, it is likely to have been very great.

#### EARTH MOVEMENTS.

The Upper Palaeozoic phase of sedimentation was brought to a close by great earth movements with an east-west trend—the Armorican or Hercynian movements. We have seen that they commenced in the Midlands before the end of the Carboniferous; they were followed by active subaerial denudation so that the Trias or in some cases Permian of Zechstein age rest upon the eroded edges of the Carboniferous rocks or even upon rocks which had been deeply buried at the close of the Carboniferous (Fig. 6). Thus, for example, in Derbyshire the total uplift in the Carboniferous limestone area has been of the order of 10,000 to 12,000 feet (3,000 to 3,700 m.).

In South Wales the uplift of the coalfield has brought up anthracite coals formerly buried under at least 14,000 feet of cover to the surface, while on the south-eastern flank of the coalfield Silurian rocks which are exposed in the core of an anticline beneath Old Red Sandstone and Carboniferous strata are now overlain by Triassic (Keuper) deposits. The depth of burial of the coal measures here was only about 5,000 to 6,000 feet, but in addition, over 3,000 feet of Old Red Sandstone together with some Silurian have been removed, or a total of approximately 10,000 feet, i.e., much the same as in Derbyshire.

The effects of these Armorican movements are well seen in places, perhaps nowhere better than at the extreme west of the South Wales coalfield in Pembrokeshire.

The Armorican movements virtually closed the structural history of England and Wales.

The succeeding Mesozoic rocks were laid down on a more or less stable platform of various older rocks which had been rendered rigid by two Palaeozoic earth movements and had become tectonically dead. They exhibit in different places many examples of small differential movements of the platform which, if you forget about the scale of the phenomenon, can be made to look much like those of the Palaeozoic era. The most remarkable of these movements are those which led to the formation of the deep basins now occupied by Trias, such as the Cheshire Basin, east of the Malverns, the Vale of Eden and Carlisle basin, the Vale of Clwyd and possibly under the later rocks of the South of England.

After the Oligocene the South of England was, however, affected by folding so that some of the rocks were considerably warped on east-west axes of folding; this is a front-wave of the Alpine movements. It is probable that the rigid foundation on which these lie partook in some degree in these

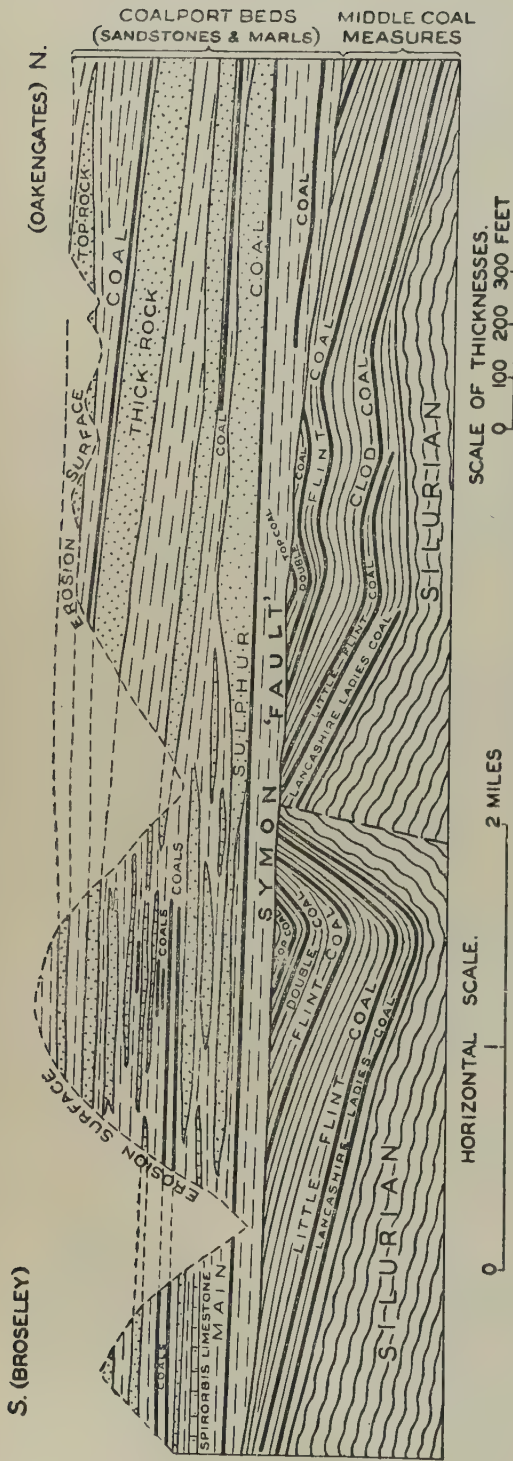


FIG. 7.—Reconstructed section through the Coalbrookdale Coalfield, showing the unconformity termed the Symon "Fault" between the Upper Coal Measures (Coalport Beds) and the Middle Coal Measures.

Folds subsequent to the deposition of the Coalport Beds have been eliminated by taking the Sulphur Coal as a datum line; in consequence, the erosion surface in the diagram does not represent the present topography. (After T. H. Whitehead: from F. H. Edmunds and K. P. Oakley, "British Regional Geology: The Central England District," *Geol. Surv.*, 2nd Edition, 1947, p. 47.)

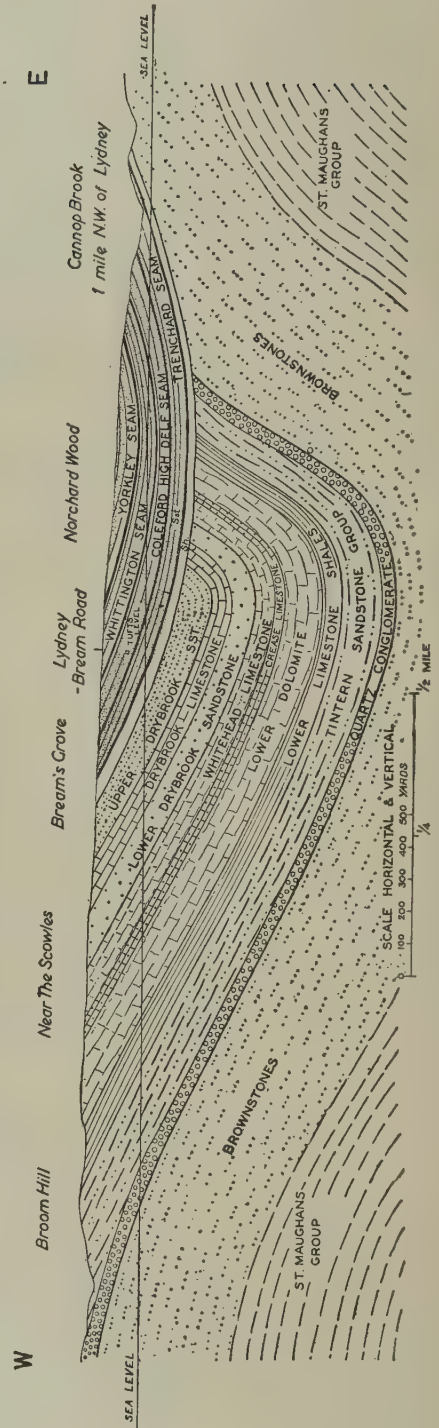


FIG. 8.—Section across the Southern end of the Forest of Dean Coalfield. (After G. A. Kellaway and F. B. A. Welch, "British Regional Geology: Bristol and Gloucester District," *Geol. Surv.*)

warping movements, but it has been suggested that some of the sharper folds may be due to the effect of varying thicknesses of cover on the rigid foundation. The effects of this folding can be traced into S. Wales and the South-west of England and there is little doubt that the rigid base on which the Mesozoic rocks rest was there warped during that period of folding. I attempted to show many years ago that the surface and drainage features of the western region may have been materially controlled by these folds. Later investigations have shown that the behaviour and trends of some of the fold axes are less simple than is suggested in that diagram.

It only remains for me to hope that those who have already participated in excursions have had a good time and to wish those with excursions ahead of them a very pleasant time. I hope too that our perpetual enemy, the "Clerk of the Weather," will be kinder to you than to those who have already had some experience of his vagaries.

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At the request of the Chairman, Professor H. H. Read, a vote of thanks to Professor Jones was proposed by Professor Léon Collet.

Professor Collet spoke as follows:—

"It is a friend from Switzerland who is speaking, that is, from a country made up of folds which have come out from a big geosyncline.

These structures are younger than those exhibited by Professor O. T. Jones; and having been told, in my young age, to respect old age, I have thus the profoundest respect for the structures of Wales.

I have had the pleasure to see them in the field with my old friend O.T., who came with Professor Pugh, from Manchester, to Switzerland to work with me.

My dear friend, I enjoyed immensely your splendid lecture.

Mr. President, ladies and gentlemen, you have listened to a great master on a master subject. I have thus the honour and the pleasure to propose a vote of thanks."

*The vote of thanks was approved with applause.*



# THE STRUCTURAL HISTORY OF SCOTLAND

By Sir EDWARD B. BAILEY, F.R.S.

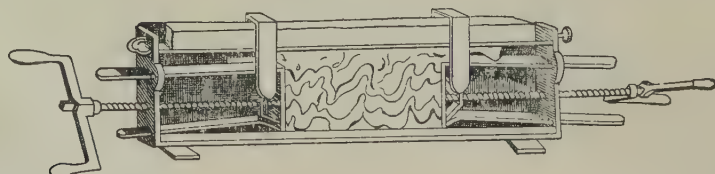
Special Address to the General Assembly in the Lecture Theatre of the Royal Geographical Society at 8-30 p.m. on Friday, August 27th, 1948

As early as 1796 de Saussure, first of Alpinists, suggested *refoulement latéral*, or, as we say in English, lateral compression, to account for the bizarre arrangement commonly exhibited by the strata of his native mountains. Some fifteen years later, in 1812, Sir James Hall, founder of experimental geology, advocated before the Royal Society of Edinburgh the very same idea in relation to the folding of the Silurian of the Southern Uplands of Scotland. He attributed the phenomenon to horizontal thrust, and imitated it by compressing layers of cloth between the jaws of a vice (Fig. 1). During the next seventy years, British geologists did much to unravel the details of small-scale tectonics in various parts of our islands—and by observation and experiment to explain the nature of slaty cleavage; but we must look to workers abroad for the first recognition of large-scale tectonics with associated over-thrusting. Thus it was Escher von der Linth in 1841 who began to speak of *Ueberschiebung*, that is overshoving, in the Glarus Canton of Switzerland; it was Logan in 1861 who employed a similar explanation to account for superposition of older strata upon younger along the Appalachian front near Quebec; and it was Cornet and Briart in 1877 who gave an excellent description of overthrusting in the Belgian coalfield.

Then in the early eighties discovery followed quick upon discovery along the north-west front of the Caledonian Chain in Scotland. The first steps forward were taken by Callaway and Lapworth. The latter, as one can so well understand, temporarily went off his head with the excitement of research;



FIG. 1.—(a) *Folded Silurian at Fast Castle on the Berwickshire coast, after James Hall, 1812 (1815).*



(b) *Experimental imitation of mountain folding, after James Hall, 1812 (1815).*

(After E. B. Bailey, "Tectonic Essays: mainly Alpine," Oxford University Press, 1935, p. 12.)



FIG. 2.—Map of Scotland.

Localities: Ab, Aberfoyle; Abd, Aberdeen; Ap, Applecross; Ar, Ardrishaig; Arn, Ardnamurchan; As, Assynt; Ba, Ballachulish; Bf, Banff; BL, Ben Ledi; BLI, Ben Loyal; Bl, Ballantrae; BN, Ben Nevis; Bt, Bute; Ca, Callender; Ch, Cheviot; Cr, Cruachan; Cs, Colonsay; Cu, Cullen; Dd, Dundee; Ds, Distinkhorn; Du, Durness; Edinb, Edinburgh; Er, Ereboil; Fa, Fannich; Ga, Garve; GB, Gruinard Bay; GC, Glen Coe; Gi, Girvan; Gl, Glenelg; Ha, Harris; Hd, Haddo; He, Helmsdale; Hu, Huntley; I, Inellan; In, Inchbae; Io, Iona; It, Inishtrahull; K, Kirriemuir; LA, Loch Awe; LC, Loch Carron; LG, Loch Glencoul; LL, Loch Laxford; LLo, Loch Lomond; LM, Loch Maree; Ls, Lesmahagow; LT, Loch Torridon; Mf, Moffat; NE, North Esk; Pe, Peterhead; Pl, Pentlands; Po, Pomeroy; Pt, Pitlochry; Rg, Rogart; RM, Ross of Mull; S, Strontian; Sh, Schiehallion; S.Pt., Strathly Point; St, Stonehaven; Sy, Stornoway; Ta, Tayvallich; Tr, Tarskavaig.

(After E. B. Bailey and O. Holtedahl, "Northwestern Europe: Caledonides," *Regionale Geologie der Erde*, 1938, p. 31.)

and it was left to Peach and Horne to bring the great task to fruition. Peach and Horne, Heim has aptly called them twin investigators. Their brilliant field-work, combined with equally brilliant exposition has, in the words of Suess, rendered our northern mountains transparent. Their contribution to the understanding of folded mountain chains is acknowledged throughout the world, wherever the language of geology is understood. It is equal in importance, though not of course in geographical extent, to the achievements of Törnebohm, the Giant Conqueror of the North, to whom we owe most of our corresponding knowledge of the south-east front of the Caledonian Chain in Scandinavia.

This Caledonian Chain, of which I am now speaking, was named by Suess, as you will all remember, in honour of Scotland and Scotland's geologists. It grew up in stages during and at the close of Early Palaeozoic times; and its deeply eroded plications are in many places overlain unconformably by Devonian of Old Red Sandstone facies.

Before you is a schematic map of Scotland, divided into two unequal parts by the Moine Thrust traced by Peach and Horne (Fig. 2). To the north-west lies the foreland, partly broken, of the Caledonian Chain. To the south-east the chain itself, half-covered by later deposits. The mountain rocks neighbouring the Moine Thrust are known as Moine Schists or Moinian.

As regards the foreland, I have barely time to do more than draw your attention to the Hebridean Shear Belt, traced by Dougal, Jehu and Craig. Along its sinuous course there has been a wonderful development of shearing which has broken down Lewisian gneiss with production of shear planes inclined south-east at angles sometimes as low as  $25^\circ$ . The sheared rocks are remarkable for the manner in which they are traversed by semi-vitreous veins, which were rendered mobile by partial fusion due to frictional heat. The field evidence suggests that, while movement was proceeding along the Hebridean Shear Belt underground, an enormously thick Torridonian conglomerate, still partly preserved at Stornoway, was accumulating at the surface.

I have now mentioned two of the three main rock-groups of the Caledonian Foreland: the Lewisian Complex, with a great variety of igneous gneisses; and the Torridonian, much of it a chocolate-brown sandstone or arkose resting unconformably on the Lewisian. The list is completed by a Cambro-Ordovician succession, starting with a white quartzite, which in turn rests unconformably, here upon Torridonian, there upon Lewisian.

Now let us look at this more detailed map illustrating the Caledonian mountain-front in the famous district of Assynt (Fig. 3). Its more westerly part belongs to the undisturbed region of the Foreland, where Lewisian, Torridonian and Cambrian behave normally one to another. Overlying this, and outcropping to the east, is a broken zone, in which all the rocks, except certain syenite intrusions lettered S, are recognizable as Lewisian, Torridonian, or Cambrian; but these no longer behave normally to one another, for they have been so shuffled by earth movement that any one of them may lie on top of any other. Above this broken zone and separated from it by the Moine Thrust, comes a great spread of Moine Schists, sedimentary but crystalline. Their characteristics, if we take into account their metamorphism, distinguish them from all the rocks of the Foreland.

What you see in this map is representative of the north-west front of the Caledonian Chain. The shuffled condition of the rocks of the broken zone may lead to any imaginable departure from normal order of superposition. Here, for instance, we find Torridonian passing under Cambrian, under Torridonian, under Cambrian; and here Torridonian capped by Cambrian, and this in turn along the skyline by Lewisian (photographs not reproduced).

Let us next look at a schematic map of a district well to the south of Assynt. It reaches from Loch Maree to Skye (Fig. 4). Its western portion is unmoved Foreland. This eastward passes under the usual broken zone, in which much the most important local element is furnished by the Kishorn Nappe. The last-named in turn passes eastward under the Moine Nappe. Sometimes other nappes intervene between the Kishorn and Moine Nappes; and of these the Tarskavaig Group is specially noteworthy.



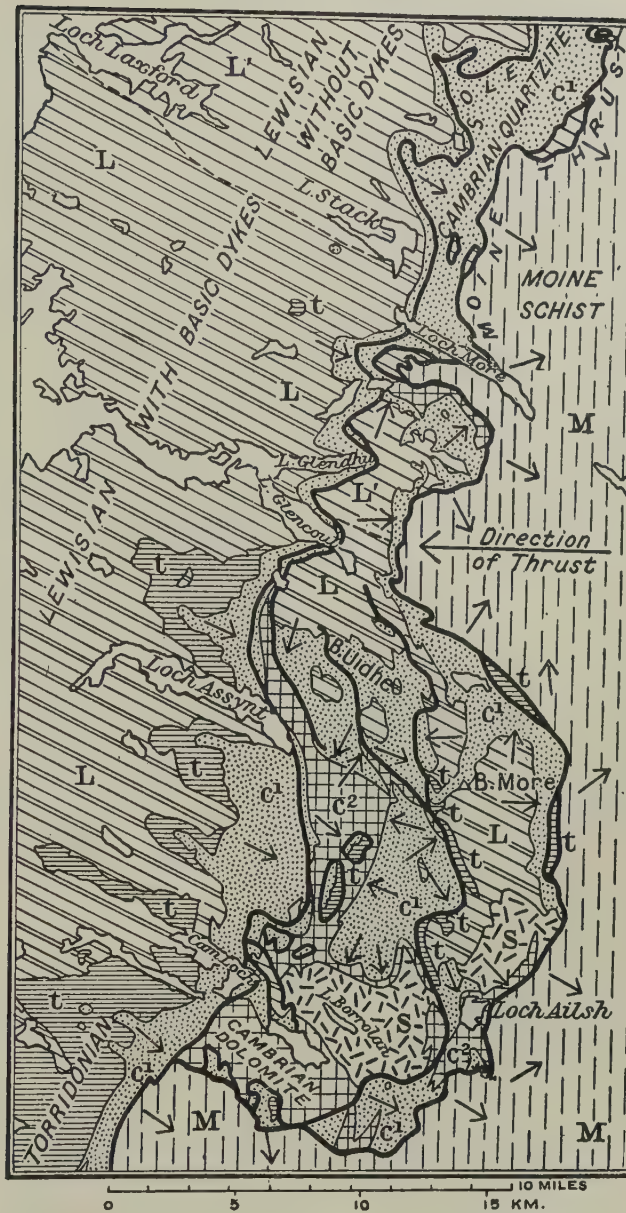


FIG. 3.—Map of Assynt, slightly modified after Peach, Horne and others.

(After E. B. Bailey, "The Glencoul Nappe and the Assynt Culmination," *Geol. Mag.*, vol. lxxii, 1935, p. 152.)

Lewisian is recognized in all these structural units. In the Foreland it is associated with Torridonian, wholly unmetamorphosed. In the Kishorn Nappe, it is again associated with Torridonian; but in this case the Torridonian is in part metamorphosed; for east of the line letter "b" on our map it everywhere carries microscopic flakes of biotite. In the Tarskavaig Nappes the Lewisian is associated with Torridonian types of sediment, which are of a metamorphic grade intermediate between the highest found in the Kishorn Nappe and the lowest found in the Moine Nappe. In fact they locally contain biotite visible to the naked eye. Some claim these Tarskavaig sediments as Torridonian,

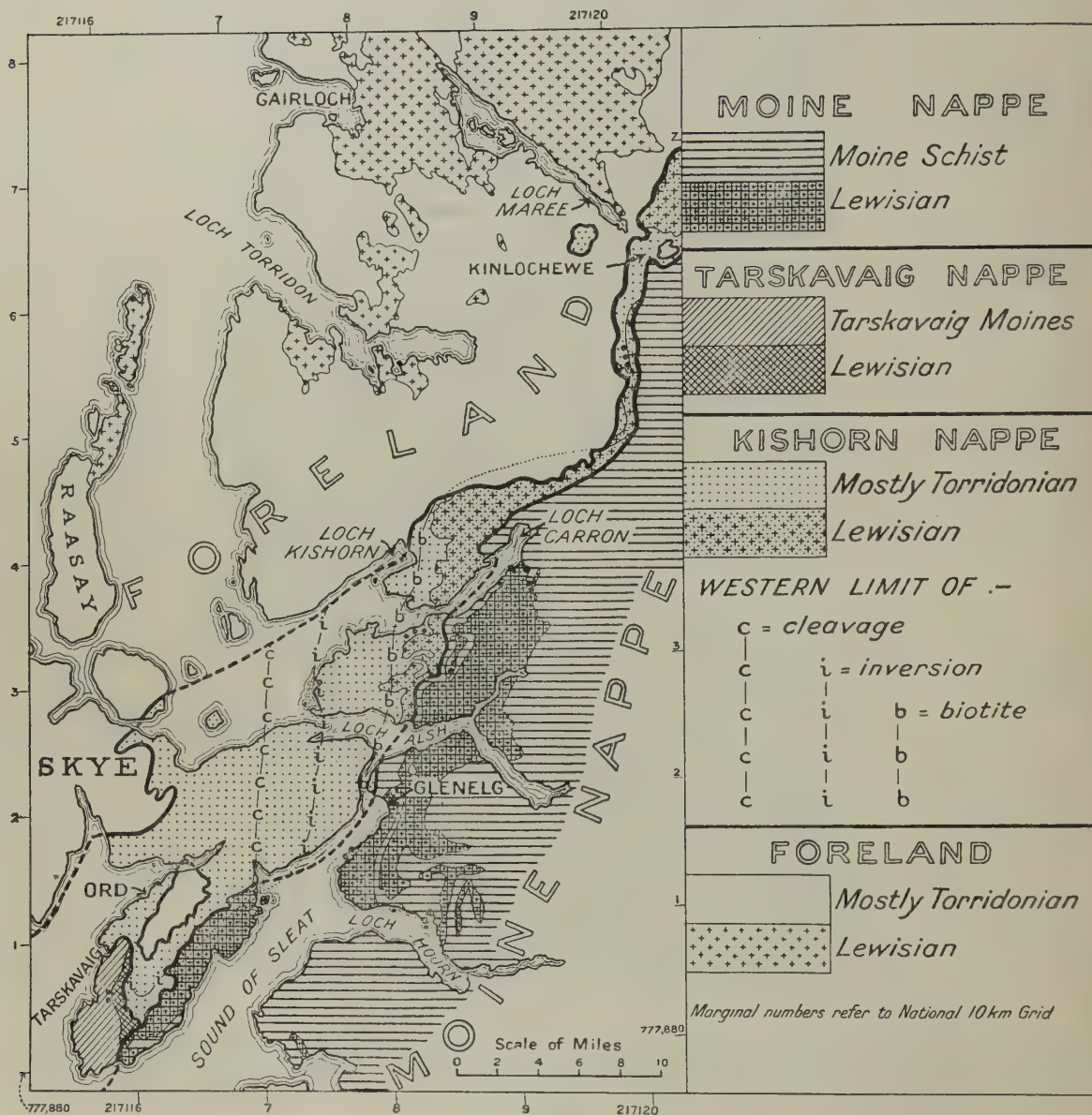


FIG. 4.—Map of pre-Mesozoic rocks, Loch Maree to Skye, essentially after Peach, Horne and Clough. Dots indicate conglomerate exposures.



others as Moinian. In the Moine Nappe the Lewisian is associated with typical Moinian sedimentary schists, in which biotite is easily seen in hand specimens and garnet is a frequent accessory.

Two vexed questions invite discussion: the first, what is the age of the present metamorphism of the Moine Schists? The second, can the Moine Schists be correlated with any of the rock groups of the Foreland? Both these difficult questions have a literature of their own, to which I have no time to attempt to do justice. More especially I crave indulgence from my Scandinavian friends. I fully recognize the importance of the Ordovician and Silurian fossils they have found in the crystalline schists of their part of the Caledonian Chain. I never forget the story Reusch told me of his first discovery of such fossils. He had toiled unavailingly for a fortnight. He had packed his bag and stood waiting for a horse and trap at the inn door. He had a few minutes to spare. He idly crossed the road, to look at a rock face immediately opposite. There were the fossils! The carriage, when it came, was sent empty away. To-night, however, I propose to adopt an insular aloofness, and tackle the question of the present-day metamorphism of the Moines on the basis of strictly Scottish evidence.

Kennedy and I have very carefully considered the age of this metamorphism, and we regard information supplied by the Moine Nappe in Skye as particularly illuminating. The Moine Nappe in Skye is composed preponderantly of Lewisian Gneiss with minor associates of Moine Schist. The metamorphism of this Moine-Nappe Lewisian differs markedly in certain general features from the metamorphism of the neighbouring Foreland Lewisian, as seen for instance in Raasay. This, of course, in itself suggests that the Moine-Nappe metamorphism of the Lewisian in Skye may be of Caledonian date. Confirmation is afforded by closer examination. We find in this Moine-Nappe metamorphism certain localized features which have evidently been controlled by proximity to or distance from the Moine Thrust. Let us examine the marginal Lewisian that outcrops within an easily recognized belt sometimes two miles wide measured from the thrust, and compare it with what lies farther away from the thrust. The near-thrust Lewisian is relatively flaggy or fissile; its mineral banding is much more closely spaced, and its mineral grains are much smaller and are arranged with much greater parallelism. It is certain that these features are due to a concentration of intense shearing into a zone attending the Moine Thrust. They are, in fact, products of what our President Read has called dislocation-metamorphism. This does not mean that the small crystals of the shear zone have resulted from mere mechanical disintegration. Such a view is untenable, since many of the crystals are well-formed and unbroken. Clearly, crystallization has accompanied movement along the Moine Thrust; that is, the metamorphism of the fine-grained laminated types of the Lewisian of the Moine Nappe in Skye is of Caledonian date. The next step is easy. The mineral assemblages of the laminated and unlaminated portions of the Lewisian of the Moine Nappe in Skye are the same, and the textural contrasts separating the two are bridged by intermediate types. Therefore the present-day metamorphism of all the Moine-Nappe Lewisian of Skye is of Caledonian date. Microscopic examination extends this momentous deduction to include the metamorphism of the associated Moine Schists of Skye. There can, in fact, be no doubt about the contemporaneity of the present metamorphism of the Lewisian and Moine rocks here lying side by side: these two sets of rocks are often to a large extent composed of the same mineral assemblages, although within these assemblages the mineral proportions are characteristically different; moreover, the grain size and crystal habit of such minerals as occur in both sets of rocks are strictly comparable. Let us add that the metamorphism of the Moine Schists in Skye is typical of what is shown by the same formation elsewhere in other westerly portions of the Moine Nappe.

It may seem strange at first sight to have adopted an indirect approach in discussing the date of the present-day metamorphism of the Moine Schists. It should, however, be remembered that the Lewisian Complex is unique in that all Highland geologists admit that it has representatives both in the Foreland and in the Mountain-land of the Caledonian Chain.

The proof that has just been offered that the present-day Moine-Schist crystallization in Skye is of Caledonian date does not, of course, tell us whether or no these Moine Schists formerly possessed a pre-Caledonian metamorphism. For my own part I strongly favour the view that until their Caledonian



metamorphism the Moine sediments were unmetamorphosed. This view is supported, for instance, by the intermediate stages of metamorphism shown by the sediments of the Tarskavaig and Kishorn Nappes, especially as various workers have demonstrated increasing metamorphism south-eastwards in the Moine Nappe itself; it is also strengthened by evidence of unconformity between Moines and Lewisian in the Moine Nappe as indicated by basal conglomerates described by Peach, Clough and others. These conglomerates have been carefully re-examined by Tilley and myself, and we are impressed with their genuineness. In fact, I have of late joined the ranks of those who think that Peach was in all probability correct in interpreting the Moine Schists as Torridonian sediments disguised by Caledonian metamorphism.

This conclusion must not lead you to imagine that Moine Schists have all passed through a dislocation-metamorphism stage. Such is most certainly not the case. It is well known that high above the Moine Thrust, for instance in the Morar district described by Richey and Kennedy, there are coarsely crystalline Moine Schists which preserve abundantly both detrital texture and current bedding. These rocks have suffered very little indeed from shearing, and their crystallization can never have had a dislocation-metamorphism character.

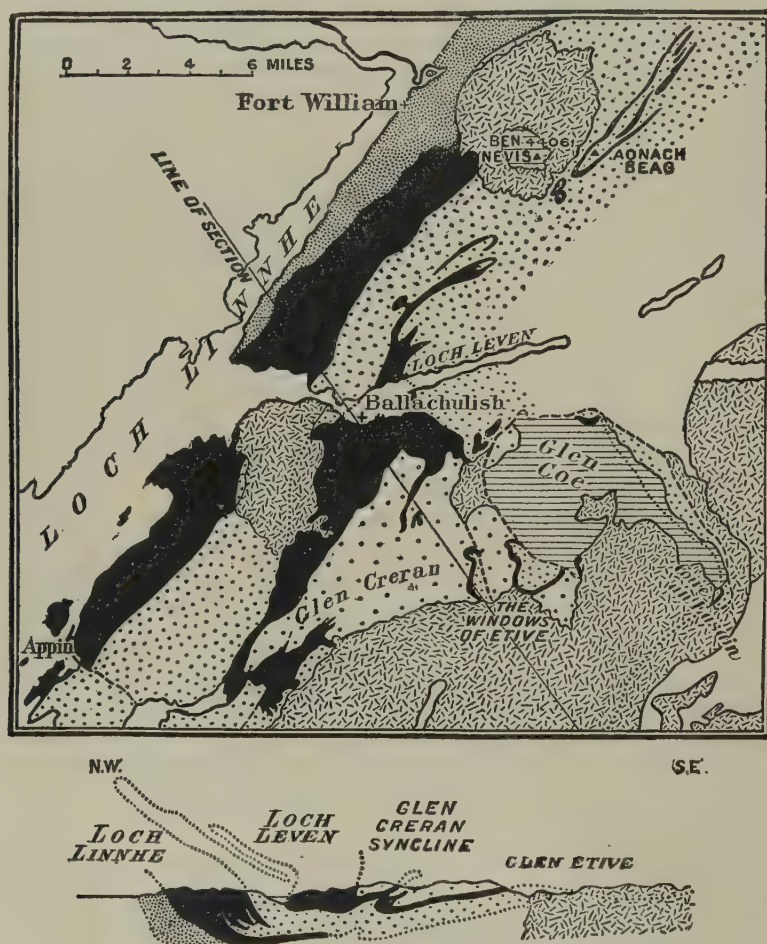


FIG. 5.—Map and section showing the Appin and Ballachulish recumbent synclines affected by the Glen Creran non-recumbent syncline or synform.

(After E. B. Bailey, in "The Geology of Ben Nevis and Glen Coe," *Mem. Geol. Surv.*, 1916, p. 81.)

Another important fact not to be forgotten is that the building of the Caledonian Chain was probably continued through millions of years. On Peach's view that both the comparatively tranquil and comparatively disturbed crystallizations of the Highland schists are of Caledonian age, one would expect to find instances where tranquil crystallization has given place to disturbed, and vice versa. The former relation can often be seen, and it has been regarded by some, I think too readily, as evidence that the tranquil crystallization is altogether older than the disturbed crystallization, to the extent of being pre-Caledonian in date. Clough, however, has demonstrated that the disturbed crystallization of the near-thrust laminated Lewisian of the Moine Nappe in Skye is in many places followed by a tranquil crystallization, which has developed conspicuous, transcurrent porphyroblasts of hornblende, biotite, chlorite and albite. In fact, the observed time-relations of tranquil and disturbed crystallizations are exactly in accordance with Peach's conception.

I must now hurry away from the Moine Thrust and Moine Schists to reach the Dalradian exposed more towards the heart of the Caledonian Chain (Fig. 2). I shall have to confine my remarks almost wholly to the Ballachulish district (Fig. 5). Here there is an extremely well marked lithological succession of formations, which many years ago enabled me to trace out recumbent folds and accompanying dislocations of truly extraordinary cross-strike extent. In the map and section before you, please concentrate your attention on the black outcrops, and the dotted outcrops. Outcrops carrying other ornaments, for instance horizontal ruling for Devonian lavas and crosses for Devonian granites, do not concern us at present. The black outcrops correspond with several formations, which together furnish the cores of two specially important recumbent synclines. The dotted outcrops correspond with several other formations, which together furnish envelopes to the aforesaid synclinal cores. The density of the dotting has been varied to bring out more clearly the relative structural positions of the envelope formations in their three main outcrops.

At first when I traced the recumbent folds of the Ballachulish district, I could not distinguish between recumbent anticlines and recumbent synclines. The existence of recumbent folds was clear, for I found in certain extensive sub-districts the formations in the order A on B on C on D, and in others D on C on B on A. But I could not find evidence to decide which of these two orders of superposition was original, and which inverted. Was A younger than B, or was it older? That was the question. Then a wonderful thing happened. Three young graduates from abroad, Vogt, Rove and Buckstaff, visited the exposures and supplied the answer. They based their finding on current bedding. Probably all of you know how current bedding, as a result of penecontemporaneous erosion, often produces a marked contrast between truncated tops and asymptotic bases; so that a structure is produced which will at once betray any subsequent inversion. It so happens that in many parts of the Ballachulish district current bedding is abundantly preserved—especially near Kinlochleven, where any one without other geological knowledge can satisfy himself that the rocks of the district are consistently upside down for a distance of six miles measured across strike.

I do not think that an inverted fold-limb, measuring several miles, in cross-strike extent, can possibly have resulted from rotation *en masse* through the vertical. I think it is self-evident that the inversion has followed the same plan as is usually adopted in turning any big piece of cloth, say a carpet, upside down. We develop a fold, the hinge of which travels forward with the inversion, but at only half the pace of the inverted portion of the cloth. Thus inversion increases as one bit of carpet after another passes in succession through the vertical from normal to inverted round about the hinge of the fold. If, encouraged by relativity, we consider for convenience the hinge of the fold as stationary, then we realize that the carpet is flowing round it with, in its still uninverted part, the backwash motion of an eddy.<sup>1</sup>

The recumbent folding of the Ballachulish district was accompanied by a development of important fold-faults, or slides as we call them. In this, of course, it resembles recumbent folding already described

<sup>1</sup> Eddy is here used in the broad popular, rather than in the restricted hydrodynamic, sense.

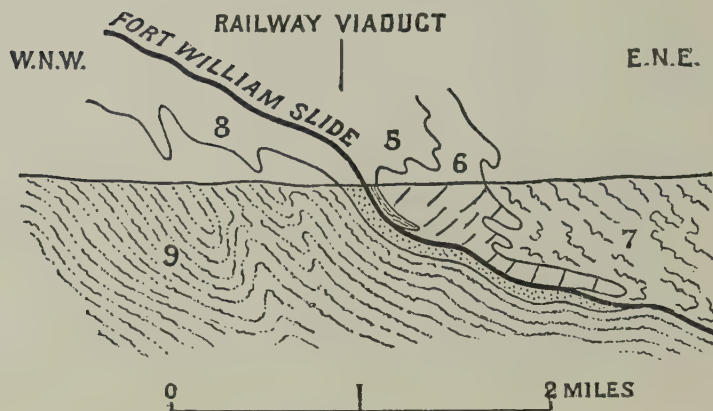


FIG. 6.—Section of the Fort William Slide (Lag) in the Spean Valley.

5, Ballachulish Slates; 6, Ballachulish Limestone; 7, Leven Schists; (of intermediate age between 7 and 8, but omitted by the slide: Glen Coe Quartzite; Binnein Schists; Binnein Quartzite; Eilde Schists); 8, Eilde Quartzite; 9, Eilde (Moine) Flags. Of these 5 is youngest, 9 oldest.

(After E. B. Bailey, "Eddies in Mountain Structure," *Quart. Journ. Geol. Soc.*, vol. xciv, 1938, p. 608.)

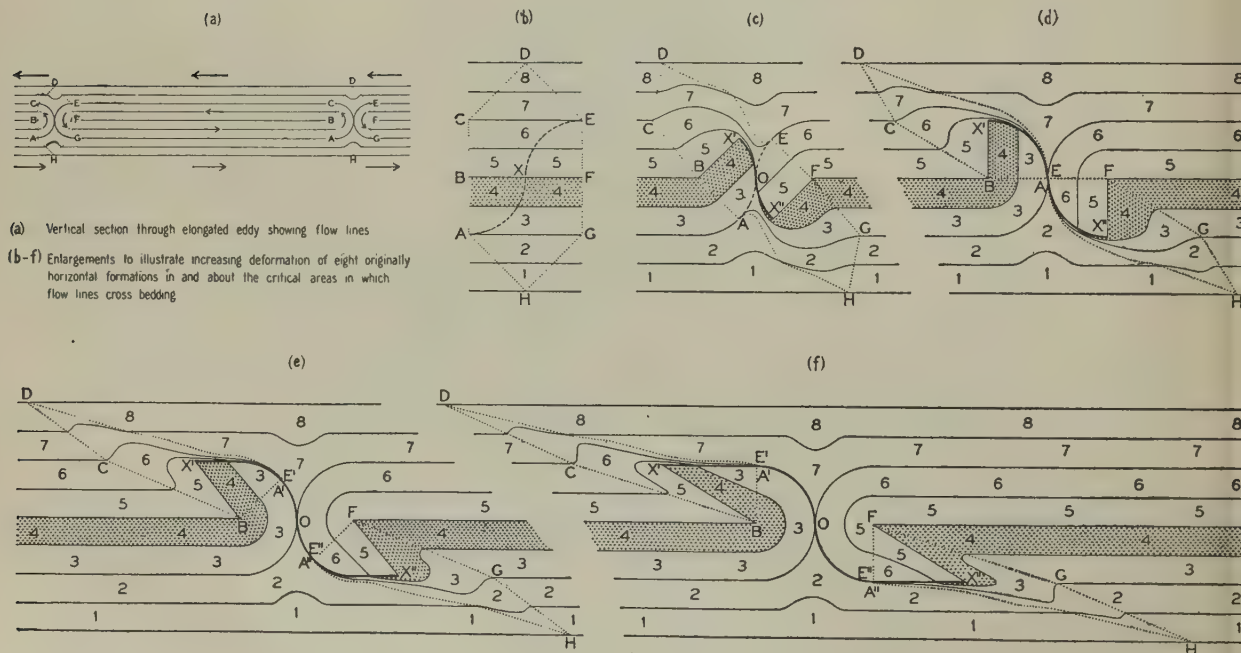


FIG. 7.—Eddy Diagram.

The thin lines in (a) represent flow planes, whereas those in (b-f) represent bedding planes progressively distorted by the flow represented in (a). (After E. B. Bailey, "Eddies in Mountain Structure," *Quart. Journ. Geol. Soc.*, vol. xciv, 1938, p. 614.)



from other regions. There is, however, a very important difference, which became manifest as soon as the original order of stratigraphical succession was established by current bedding. The most important slides of the Ballachulish district attenuate or cut out sequences in normal, rather than in inverted, limbs. That is, they are what we call lags, rather than thrusts.

Look at this section showing one of the main slides of the Ballachulish district (Fig. 6). The formations have been numbered from 5 to 9, where 5 is the youngest and 9 the oldest. You will note that the slide cuts out formations 6 and 7 where they would have been in normal superposition, with 6 overlying 7; and that it leaves them untouched where they are inverted, with 7 overlying 6. The fold above the Fort William Slide is not an anticline, as would have been the case if the slide had been a thrust. Instead it is a syncline.

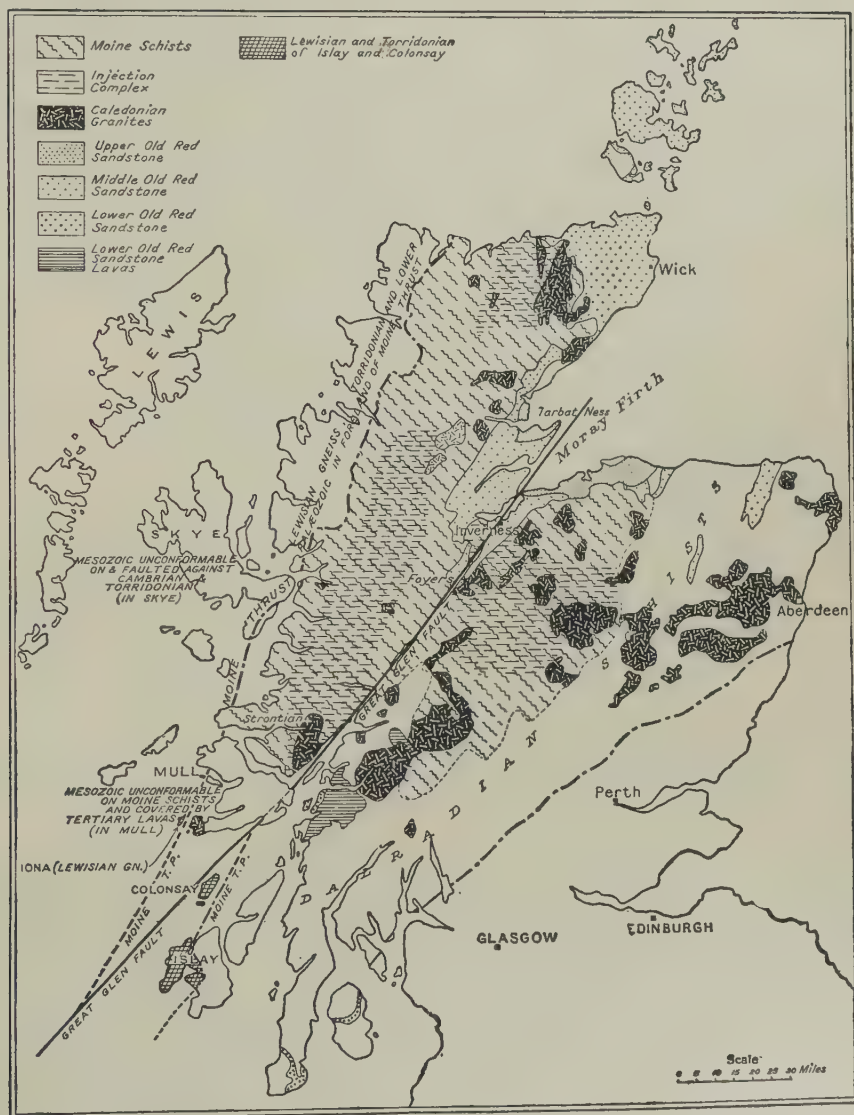


FIG. 8.—Map of Great Glen Fault.

(After W. Q. Kennedy, "The Great Glen Fault," *Quart. Journ. Geol. Soc.*, vol. cii, 1947 for 1946, p. 48.)

Analysis of the flow lines required to account for the lags and associated inversions in the Ballachulish district leads to an eddy-like picture, such as you have presented in the diagram on the screen before you (Fig. 7). The eddies of course, have horizontal axes.

Now we must hurry on once more, leaving Ballachulish and many other choice districts behind us. In passing let us pause for a moment to glance at the flat belt of Loch Tay (Fig. 2). This has long been famous, because for many miles across strike the Loch Tay Limestone lies so flat that it roughly contours a number of adjacent valley sides. I believe that all the rocks of this belt are inverted; but the stratigraphical evidence comes from outside the district, and local confirmation would be extremely welcome. Tilley has made a good case for inversion of metamorphic zones in connection with the Loch Tay inversion of stratigraphy; for he has pointed out that over a wide stretch of country conspicuously garnetiferous pelitic rocks overlie other pelitic rocks in which garnet is rare or absent.

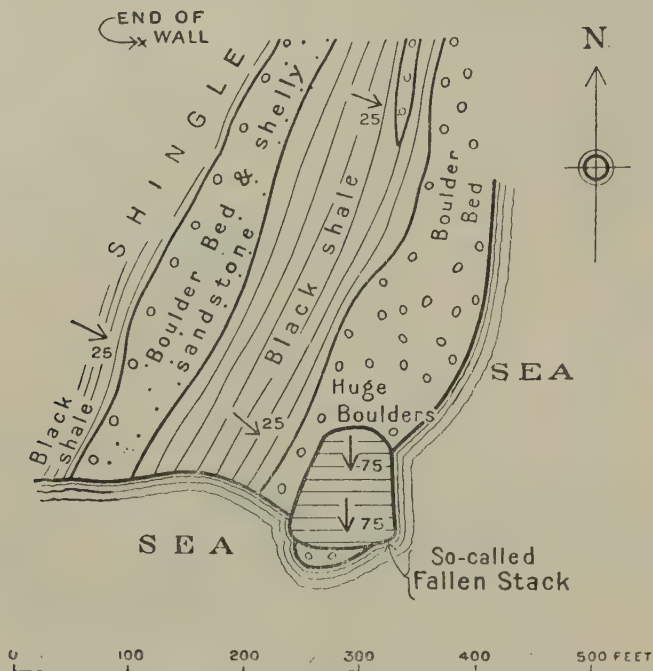


FIG. 9.—Map showing relations of the Portgower giant boulder, the so-called fallen stack.

Arrows show dips in degrees. (After E. B. Bailey and J. Weir, "Submarine Faulting in Kimmeridgian times, East Sutherland," *Trans. Roy. Soc. Edinburgh*, vol. lvii, 1932, p. 446.)

I am not, however, convinced that the deduction is secure, for the garnetiferous pelites are overlain, as well as underlain, by non-garnetiferous companions; and it seems possible that their garnet development may have been favoured by some chemical factor not as yet determined.

South-east of Loch Tay we reach the Highland Border, still abounding in problems. Henderson and Pringle have both made important contributions of recent years; Henderson through discoveries of graded and current bedding; and Pringle, of Middle Cambrian trilobites. Then we come to the Midland Valley occupied by post-Caledonian sediments. Beyond, follow the Southern Uplands, where the Caledonian Chain is seen for the last time in Scotland. Here, fossiliferous Ordovician and Silurian strata are disposed in a succession of steep folds, comparable with those characteristic of the Jura Mountains. There has been no revolutionary change in the interpretation of these structures since 1812 when Hall exhibited to the Royal Society of Edinburgh the sketch of the folded Silurian of the Berwickshire coast, with which I started this lecture (Fig. 1).

# SPECIAL ADDRESSES

Leaving further consideration of the Caledonian Chain, I wish now to devote a few words to one of the best known faults in the world, the Great Glen Fault, which geographically separates our Scottish Highlands into two roughly equal portions (Fig. 2). Kennedy, a few years ago, was co-ordinating our knowledge of pegmatite injection that regionally affects extensive tracts of Moine Schists on both sides of the Great Glen Fault. He found that the distribution of the injection complex had undoubtedly been rendered discontinuous by the Great Glen Fault (Fig. 8). To account for the separation at the present level of erosion by horizontal displacement, one would have to postulate a relative travel of the South-east Highlands some 65 miles north-eastwards. Kennedy already knew intimately the Strontian Granite complex which lies in the north-west belt of injection. It is abruptly truncated on the south-east by the Great Glen Fault. He therefore looked at the map of Scotland for a possible displaced continuation of this granite complex some 65 miles farther north-east. A granite was known at Foyers, which he thought might prove to be his granite errant. He went to Foyers, and found a complex containing an exactly similar association of member intrusions to that at Strontian, and moreover these member intrusions were grouped with a corresponding arrangement. This of course, may prove to be no more than an unfortunate coincidence; but I think it has justified Kennedy in publishing one of the most stimulating papers of modern times. He has supported his claim that the Great Glen Fault is a tear or wrench fault by pointing to a number of parallel faults in the Highlands, which had already been interpreted as tear or wrench faults, always with a relative north-eastward,

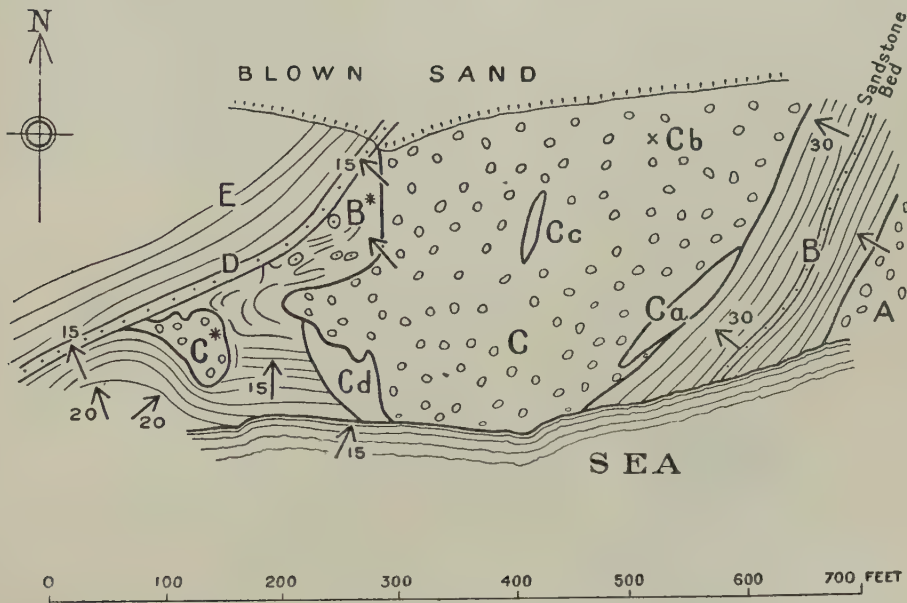


FIG. 10.—Map showing landslip relations of a Kimmeridgian boulder bed: Crackaig Links.

Arrows show dips in degrees. (After E. B. Bailey and J. Weir, "Submarine Faulting in Kimmeridgian times, East Sutherland," *Trans. Roy. Soc. Edinburgh*, vol. lvii, 1932, p. 449.)

- E. Black shales, with *Aulacostephanus*.
- D. Sandstone.

Local Unconformity due to tsunami.

- C and C\*. Boulder bed with boulders of Old Red Sandstone: Ca, 145 feet long; Cb, large; Cc and Cd, 95 feet long.
- B. Black shales, with *Aulacostephanus*. These shales are ploughed into by boulder bed (C), and at B\*, highly contorted, provide it with a partial cover.
- A. Boulder bed of older date than the shales (B); and 80 feet thick.



sinistral displacement on their south-east sides. Admittedly, in the case of these other faults displacement never exceeds a few miles in extent.

The birthday of the Great Glen Fault is, of course, a matter of great importance, though not as yet determined with certainty. Kennedy thinks that the tear-fault movement originated in Carboniferous times as a product of Armorican stresses. Be that as it may, the Great Glen Fault has certainly remained a site of much earth-movement during post-Carboniferous times; and even to-day it locates an occasional minor earthquake. It is delightful to recall that Hugh Miller as long ago as 1859 correctly interpreted earthquake records retained by certain Kimmeridgian deposits that outcrop alongside the Great Glen Fault on the shores of the Moray Firth. Much more ample evidence of the same kind has survived in connection with the parallel Helmsdale Fault not very far to the north-west (Helmsdale, but not the fault, is shown in Fig. 2). South-east of this fault lies a capital exposure of Mesozoic formations, starting with Trias (which rests on Upper Old Red Sandstone) and leading up to Kimmeridgian, the latter over 1,000 ft. thick. On the other side of the fault all the rocks now preserved are of pre-Mesozoic date—the youngest among them is flat-lying Middle Old Red Sandstone.

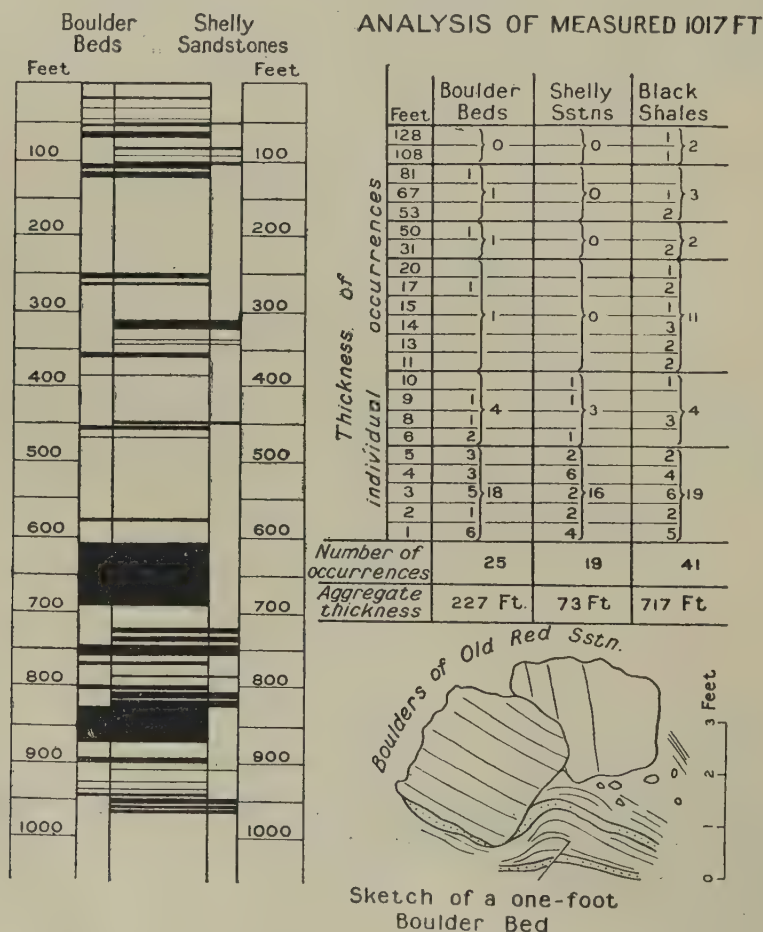
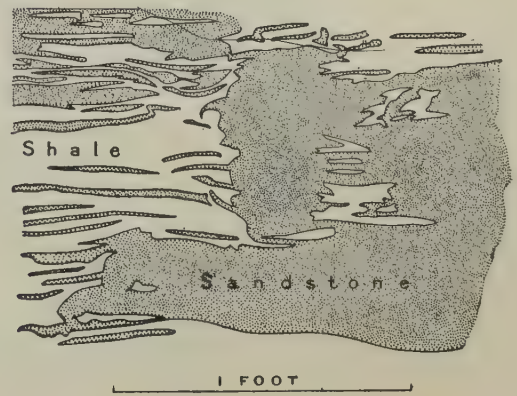
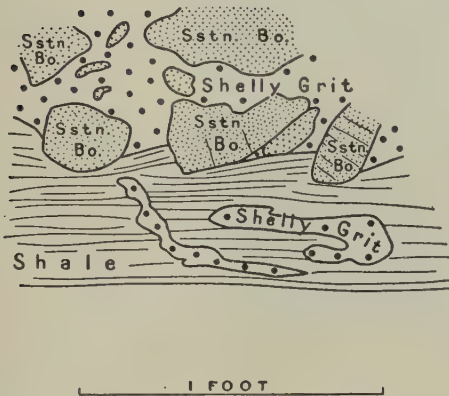


FIG. 11.—Partial section of Helmsdale Kimmeridgian.

(After E. B. Bailey and J. Weir, "Submarine Faulting in Kimmeridgian times, East Sutherland," *Trans. Roy. Soc. Edinburgh*, vol. lvii, 1932, p. 445.)

During the accumulation of the earlier Mesozoic formations, from Trias to Corallian, there was no hint of proximity of pre-Mesozoic formations. Once, however, the Kimmeridgian began to be deposited it appears that a fault-scarp was developed and maintained by intermittent movement of the sea floor, with an aggregate downthrow amounting to more than 2,000 ft. Unconsolidated Mesozoic sediments on the north-west side were dissipated without furnishing boulders; but Middle Old Red Sandstone of the fault-scarp provided repeated landslips of boulders, among which a few individuals measure as much as 100 ft. (Figs. 9, 10). The fault-scarp must have been wholly submarine, separating comparatively shallow water, characterized by rounded pebbles, sand, *Rhynchonella*, *Terebratula*, *Ostrea*, sea-urchins and reef corals, from comparatively deep water, where normally mud gathered charged with ammonites, belemnites, thin-walled lamellibranchs and debris of land-plants. Earthquakes were frequent, for we find that the landslips of Middle Old Red sandstone debris were almost always spread out by concurrent earthquake-generated waves, tunamis, to give boulder-beds. These

## SECTIONS



Injection of shelly grit into Kimmeridgian shales underlying a 5-foot boulder bed (base shown) that contains boulders up to 6 feet in length: 270 yards E.N.E. of mouth of Westgarty Burn.

Sand injected along and across the bedding of Kimmeridgian shales (unornamented): southern extremity of Culgower Bay.

FIG. 12.—*Intrusive veins of grit and sandstone.*

(After E. B. Bailey and J. Weir, "Submarine Faulting in Kimmeridgian times, East Sutherland," *Trans. Roy. Soc. Edinburgh*, vol. lvii, 1932, p. 454.)

boulder-beds have irregular bottoms that plough into underlying shale, but their tops are smoothed over by sand containing myriads of shells—a cover evidently washed down from the platform above the fault-scarp and dropped as the waves lost some of their violence. Thus it has come about that the 1,000 feet of Kimmeridgian sediments on the depressed side of the fault afford a natural seismograph, in which quiet intervals are recorded in shale, and earthquakes in boulder beds with shelly sand (Fig. 11). As might be expected, there are many examples of slumping, a few of sandstone dykes, multitudes of ramifying sandstone veins (Fig. 12) and even one instance of a fossil sand-volcano.

I still have time to devote a few remarks to the tectonics of igneous activity as revealed at various Scottish centres, notably Ben Nevis, Glencoe and Etive, of Devonian date, and Skye, Rum, Ardnamurchan, Mull and Arran of Tertiary date (Fig. 2).

This map (Fig. 13) shows the relative positions of the Ben Nevis, Glencoe and Etive centres. First let us note the swarms of parallel north-east dykes focused upon the Ben Nevis and Etive centres. It is clear that these dykes owe their parallelism to a regional stress akin to tension. Each time this

stress with co-operation of magmatic pressure reached breaking intensity, a dyke fissure was developed and concurrently injected. The fissure would in most cases be located to pass through an igneous focus where the crust was already partially perforated by a cavity occupied by molten material under pressure. Repetition of the process would thus produce a dyke swarm.

Pass now to the Glen Coe centre, where a subsided plug of lava-covered schist has gone down some 4,000 feet. As it sank, it became surrounded by an uprising, irregular ring-intrusion of granite. We speak of this particular subsidence as constituting the cauldron subsidence of Glen Coe, although its original cauldron or caldera topography has long since been effaced by erosion. The surrounding fault is a typical ring-fault.

The eroded condition of the Glen Coe Cauldron offers an excellent subject for geological study. The view opposite shows a cross section of the boundary fault (Fig. 14). Inside its circumference

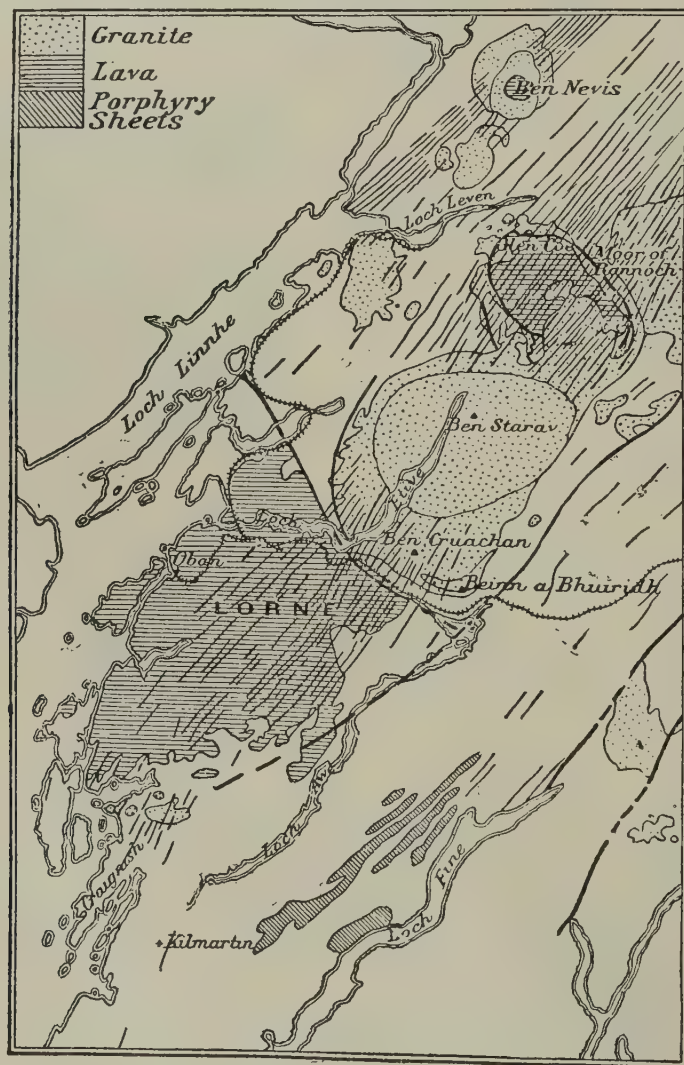


FIG. 13.—Map of the Devonian volcanic district of Ben Nevis, Glen Coe, Etive and Lorne.

Schists left white; Dykes shown by light, and Faults by heavy black lines. Scale: 10 miles to 1 inch.

(After H. B. Maufe and others, in "The Geology of Ben Nevis and Glen Coe," *Mem. Geol. Surv.*, 1916, p. 90.)



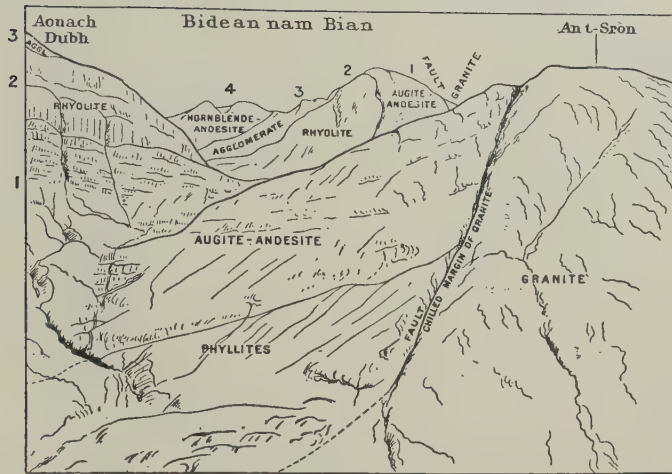


FIG. 14.—View of Bidean nam Bian from Glen Coe Road.

(After H. B. Maufe and others, in "The Geology of Ben Nevis and Glen Coe," *Mem. Geol. Surv.*, 1916, p. 94.)

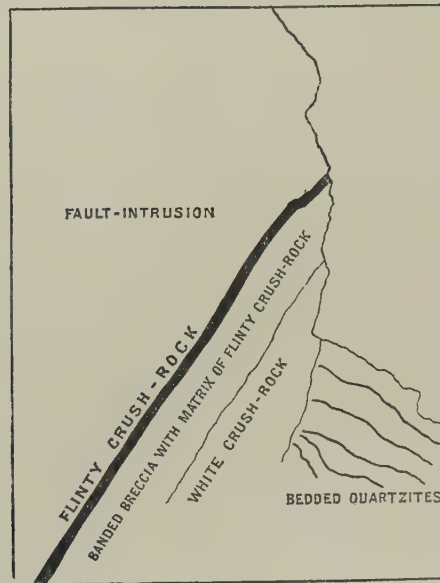


FIG. 15.—Sketch of the boundary fault of the Glen Coe Cauldron, as exposed in the low cliff of Stob Mhic Mhartuin.

(After C. T. Clough, H. B. Maufe and E. B. Bailey, "The Cauldron-Subsidence of Glen Coe," *Quart. Journ. Geol. Soc.*, vol. lxy, 1909, p. 650.)

Dalradian phyllites are seen covered by a great pile of Devonian lavas. Outside lies part of the granite that welled up circumferentially as the subsidence proceeded. The foundering internal mass brought down with itself a comparatively cold temperature from the upper regions. Of this we have a permanent record, for the granite cooled quickly against the sunken mass, giving a smooth chilled edge in contrast with a penetrative unchilled edge such as it shows in contact with schists outside the cauldron, to the right of our sketch.

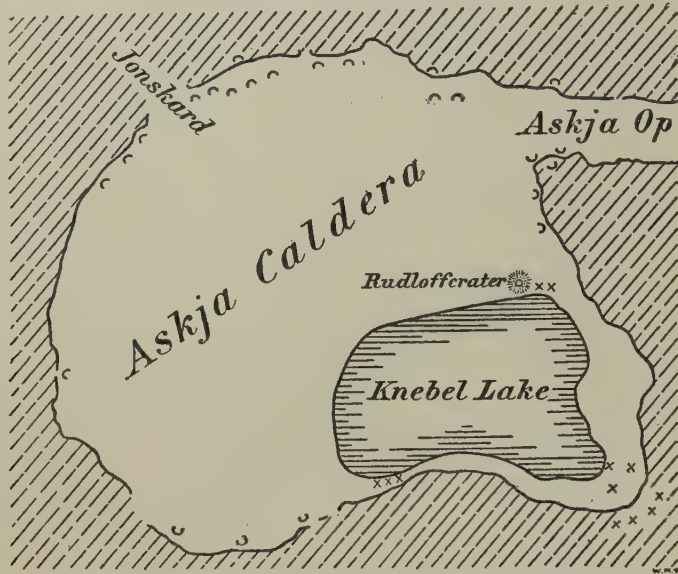


FIG. 16.—Map of the Askja Caldera, Iceland, after Spethmann, on the scale of about 1 : 90,000.

(After C. T. Clough, H. B. Maufe and E. B. Bailey, "The Cauldron-Subsidence of Glen Coe," *Quart. Journ. Geol. Soc.*, vol. lxxv, 1909, p. 668.)

There is another picturesque feature, correlated with rapid downfall within the cauldron subsidence. Often, as was recognized by Clough, frictional heat partially melted a few inches of fault rock before the granite magma, arriving on the scene, lubricated the contact. The rise of temperature was, in such a case, extremely local and the amount of heat generated, relatively minute. Thus in Fig. 15 a heavy black line represents an inch of fusion product (so called flinty crush-rock), but the granite magma to the left has notwithstanding the intervention of this temporarily heated layer been quickly cooled by conduction into the downfaulted plug of cold rocks within the cauldron.

Probably the best modern analogy of the Glen Coe Cauldron is afforded by Askja Caldera of Iceland (Fig. 16). Here, instead of a circumferential intrusion cleared by erosion, one sees rim craters grouped round a hollow due to subsidence. A minor subsidence is filled by the Knebel Lake.

Mull of Tertiary date has been the site of many ring-intrusions and of two great cauldron subsidences. The asterisks on this map (Fig. 17) mark outcrops of pillow lavas which must have assumed their pillow form through being poured out into a crater lake occupying the more south-easterly of these latter.

I have spoken of ring-faults and ring-intrusions. Scottish geologists learnt of these structures from their experiences at Glen Coe, Ben Nevis and Mull; but Thoroddsen had previously known of many examples of ring-fractures, or Kreis Brüche, as he called them, in Iceland (Fig. 18). It is difficult to look at the progressive scale of ring-fractures revealed in Iceland without wondering whether even larger volcanic arcs, such as that of the Aleutian Islands, do not belong to the ring-fracture category. If so, it is probable that many arcuate folded mountains have had their plan laid down by partial ring-fractures.

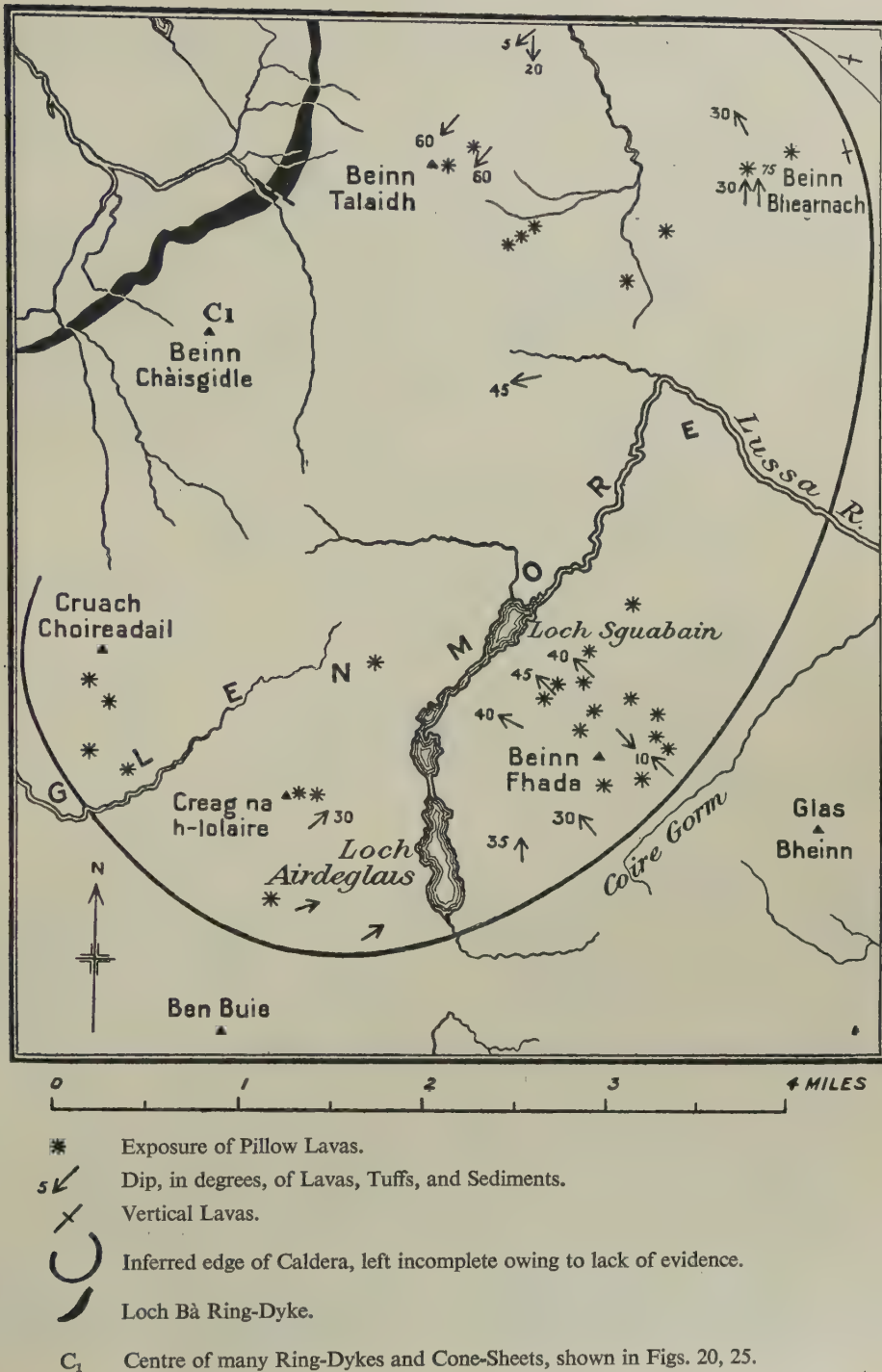


FIG. 17.—Distribution of pillow lavas, Mull.

(After E. B. Bailey, in "Summary of Progress for 1914," 1915, p. 40, and "Tertiary and Post-Tertiary Geology of Mull," 1924, p. 133, both *Mem. Geol. Surv.*)



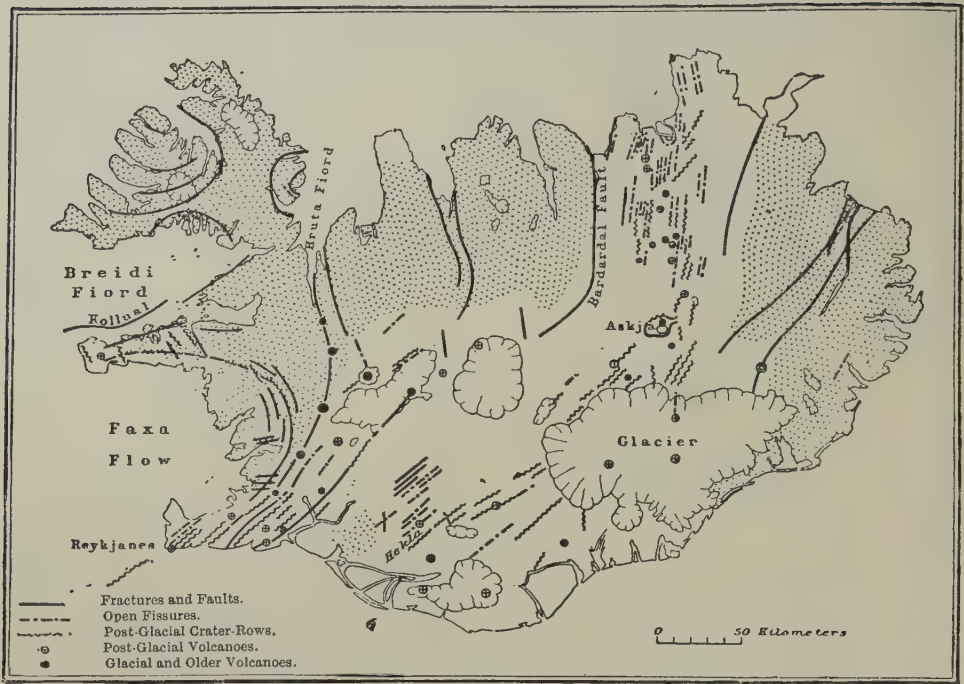


FIG. 18.—Iceland after Th. Thoroddsen.

The Early Tertiary basalts are stippled; the more recent volcanic rocks are left plain. (After E. B. Bailey, "Iceland a Stepping Stone," *Geol. Mag.*, 1919, p. 468.)

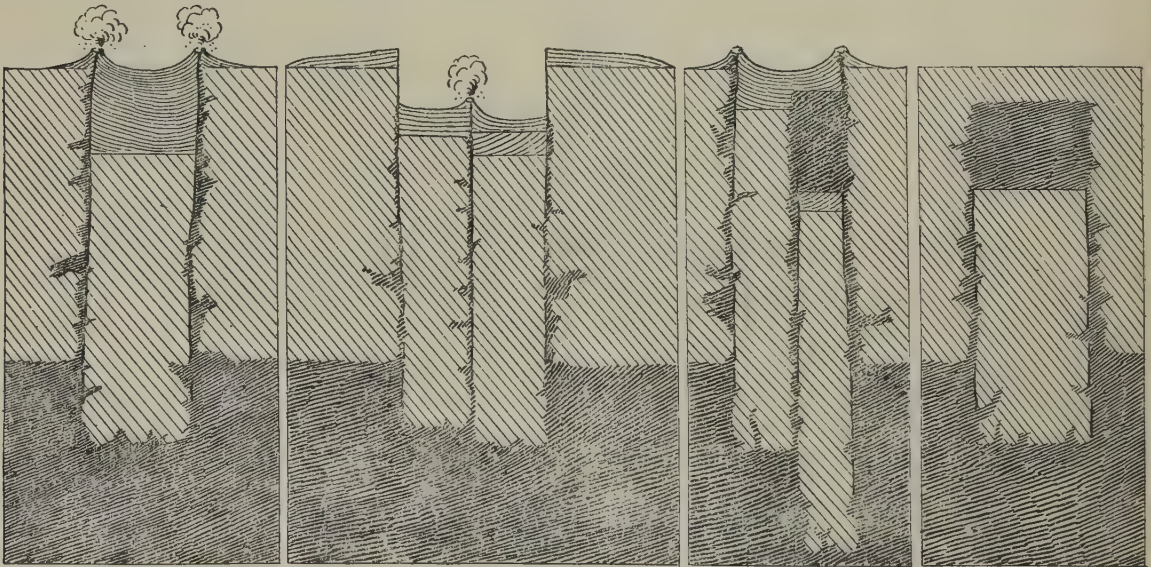


FIG. 19.—Diagram illustrating subaerial and subterranean cauldron-subsidences, accompanied by volcanic and plutonic accumulations of igneous rock.

(After C. T. Clough, H. B. Maufe and E. B. Bailey, "The Cauldron-Subsidence of Glen Coe," *Quart. Journ. Geol. Soc.*, vol. lxxv, 1909, p. 670.)



FIG. 20.—Ring-Dykes and Central Intrusions of Mull.

(After E. B. Bailey, W. B. Wright, J. E. Richey and C. T. Clough, in "Tertiary and Post-Tertiary Geology of Mull," *Mem. Geol. Surv.*, 1924, p. 307, which includes Plate V referred to above. For Caldera Margins consult Figs. 22, 25 to follow.)

# PART I: GENERAL PROCEEDINGS

I show this diagrammatic section of cauldron subsidences (Fig. 19) because it is interesting as carrying the first suggestion that certain granite intrusions occupy subterranean cauldrons. It was of course based upon our studies in Glen Coe.

In Mull a subterranean ring-graben, filled with granophyre (constituting what is known as the Beinn a' Ghraig Granophyre) is well attested. It is easy to identify in Fig. 20, because it crosses the north-west end of Loch Ba. On the other hand, most of the ring-dykes of Mull (though the same does not hold for Ardnamurchan) taper upwards to a finish, and probably represent infillings of single fissures prised open by magmatic pressure. A prise-open relationship is particularly clear near Cruach Choireadail (4.5 miles E. and 0.5 miles N. of the S.W. corner of Fig. 20). The Glen More Ring-dyke here bifurcates upwards to yield two parallel prongs connected by a lowly inclined sheet. Each of the



FIG. 21.—Map of Arran domes.

Schists, Old Red Sandstone, Carboniferous and New Red Sandstone upheaved by Tertiary intrusions. After W. Gunn with minor alterations. (After E. B. Bailey, "Domes in Scotland and South Africa: Arran and Vredefort," *Geol. Mag.*, vol. lxiii, 1926, p. 485.)





TERTIARY



Intrusions later than folds  
(dyke-swarm & cone-sheets omitted)  
Granophyres responsible  
for folds  
Basalt lavas ornamented  
to show :—

Anticlines & Synclines



MESOZOIC sediments

PRE-MESOZOIC rocks



Faults bounding main calderas

Other faults

Dip

Scale—  
5 Miles  
8 Kilometres

FIG. 22.—Map of circumferential folding, Mull.

prongs, before it begins to taper upwards, is half as broad as the handle below. One prong continues along the same fissure as further down sockets this handle. The other is guided by a parallel fissure, a quarter of a mile south-west.

More extreme examples of the operation of magmatic pressure are shown in Rum, Arran and Mull. In Arran both upward and outward displacement has been caused by a Tertiary granite, as is well exhibited in the attitude of surrounding Dalradian Schists and later sediments (Fig. 21). In Mull, outward push by an unusually large granophyre ring-dyke has developed an arcuate system of folds affecting Moine and Dalradian schists, Old Red Sandstone lavas, Mesozoic sediments and Tertiary lavas as shown in Figs. 22 and 23.

There are other points besides cauldron subsidences in which Scottish Tertiary volcanoes have adopted a pattern reminiscent of their Devonian predecessors. This is well illustrated in the Tertiary swarms of north-west dykes (Fig. 24), which are obviously analogues of the Devonian swarms of north-east dykes (Fig. 13). The recognition of dyke-swarms, one may recall, was due to Maufe, who started work in the Highlands at the crossing of the Mull and Etive swarms.

There is, however, one characteristic of Scottish Tertiary igneous activity which is altogether unrepresented among our Devonian volcanoes. I refer to cone-sheets, first recognized by Harker in Skye. They reach their fullest development in Mull (Fig. 25). Their intrusion is as intermittent as that of dykes of a dyke-swarm. Their cumulative effect, as I show in the diagram at the right top corner, is obviously central upheaval. I should not be surprised if the cone-fractures originated, a very few at a time, as a result of subterranean explosion. Cone-sheets have been so often met with at Scottish Tertiary centres, and so seldom anywhere else in the world, that I hope my audience when it scatters to distant lands will keep a special outlook for further examples. Perhaps too, if you live among folded mountains rather than volcanoes, you will bring us fresh knowledge of eddy-like deformations.

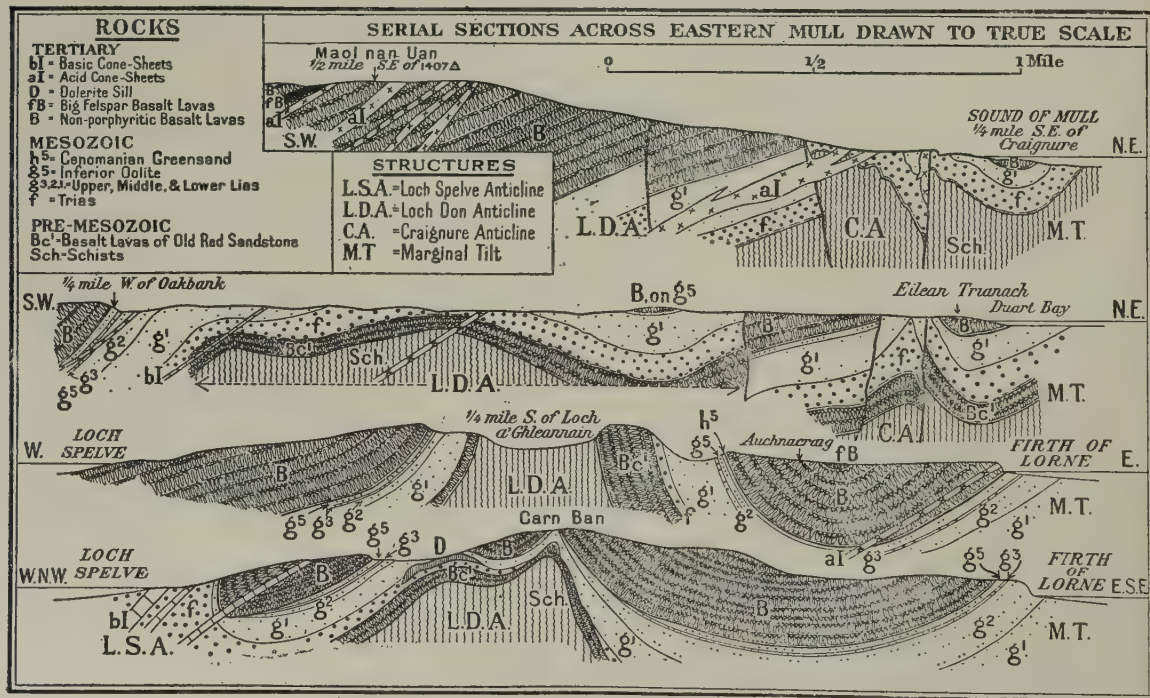


FIG. 23.—Four radial sections across folds of Fig. 22.

(After E. B. Bailey, in "Tertiary and Post-Tertiary Geology of Mull," *Mem. Geol. Surv.*, 1924, p. 174.)



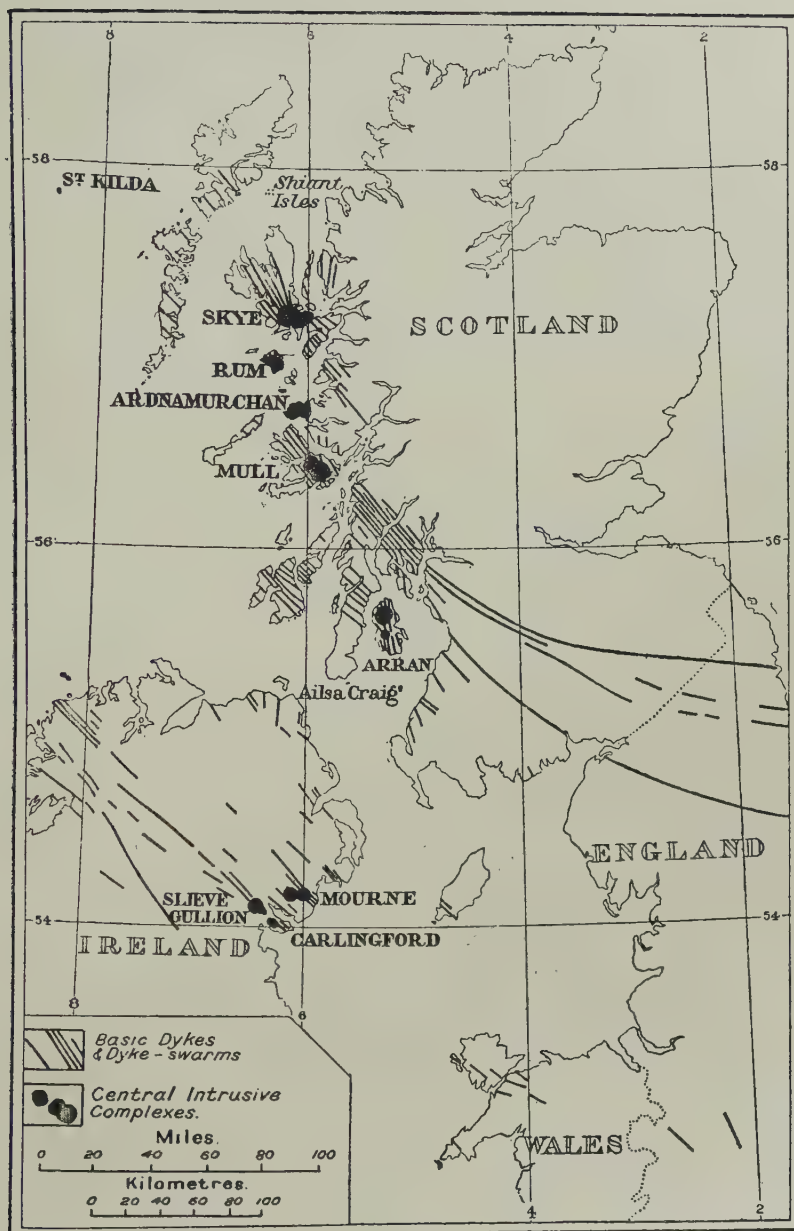


FIG. 24.—Tertiary dyke-swarms of Scotland and Ireland.

Number of dykes greatly reduced. (After J. E. Richey, in "The Geology of Ardnamurchan, North-west Mull and Coll," *Mem. Geol. Surv.*, 1930, p. 53.)



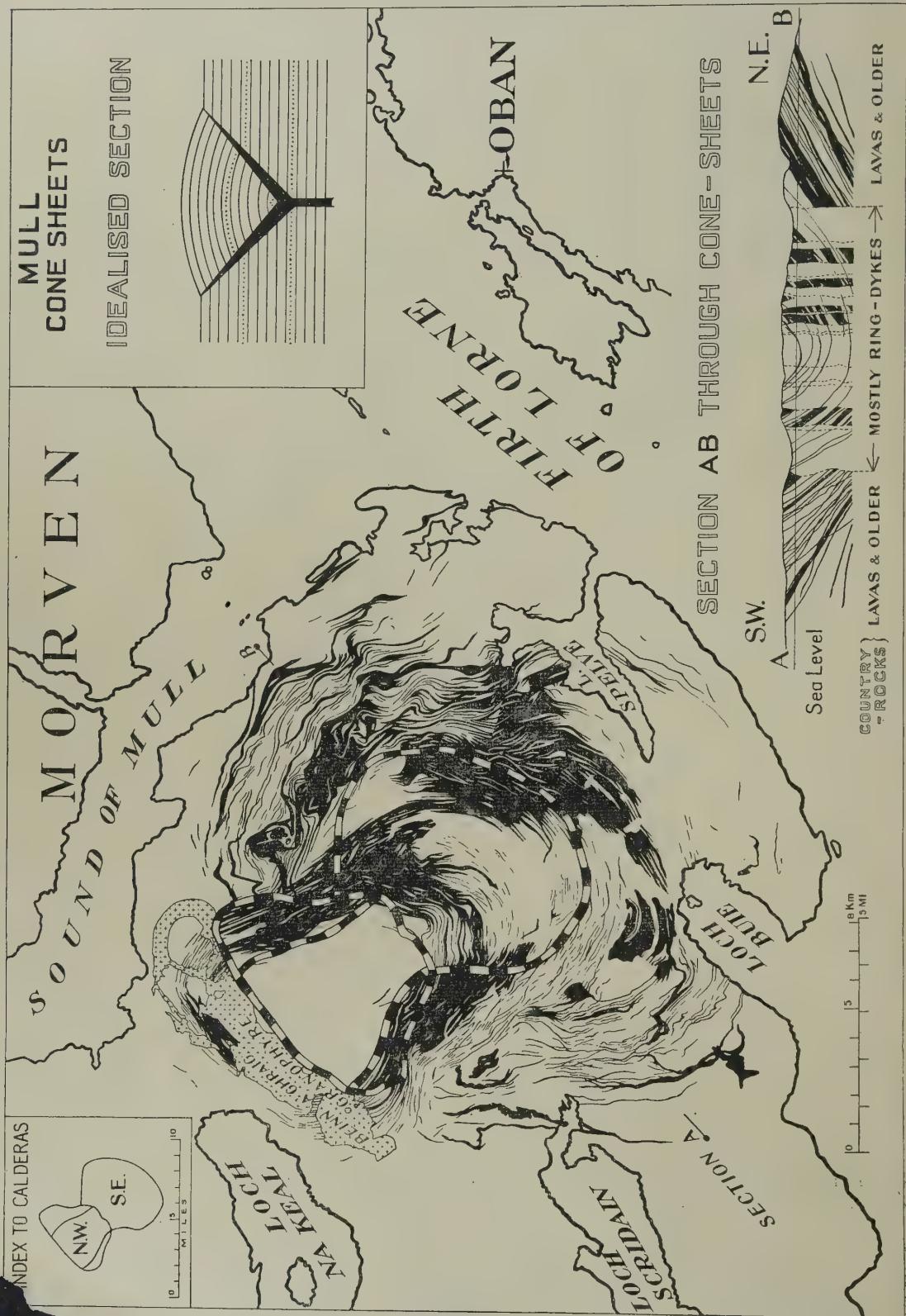


Fig. 25.—Cone-sheets of Mull.

#### SPECIAL ADDRESSES

The Chairman, Professor H. H. Read, called upon Professor O. Holtedahl to move a vote of thanks to Sir Edward Bailey. Professor Holtedahl spoke as follows:—

“It gives me great pleasure to be asked to say some words of thanks to Sir Edward Bailey for his most interesting lecture to-night. And it gives me a particular pleasure to have this opportunity, as a representative of the foreign geologists at this meeting, to pay a tribute to Bailey for the eminent work he has done during a long life, and an especial tribute to his spirit of enthusiasm and entire devotion to his science, a spirit which, indeed, has been a stimulant to geologists from many nations.

We have here, to-night, seen Bailey on this platform, lecturing, but in order to get the right idea of this man we should see him in the field, as many of you no doubt already have had the chance to do. It is said that the Vikings of olden days—whom I suppose you were not particularly fond of in this country—were strong and hardy people, but I can assure you they must have been very inferior to the Viking of the Ballachulish slide, of Glen Coe, Mull and Skye. I once heard the rumour that a British geologist, who possibly could not be any other than our lecturer of to-night, during a Congress excursion in the Swedish mountain districts in 1910, had tried to find out how it felt to go down a waterfall together with the logs of timber, but there may, perhaps, be a slight exaggeration in this rumour!

Scotland is, in the history of geology, classical ground, from where not only in one or two but in many places, new ideas of fundamental importance to geological thinking have sprung up, grown and spread over great parts of the world. On behalf of this audience I express our sincere thanks to Sir Edward Bailey for the fascinating glimpses he has given us of the structural history of this classical ground.”

*The vote of thanks was approved with applause.*

## DATE DUE

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THE UNIVERSITY OF ILLINOIS AT CHICAGO

## LIST OF THE PARTS OF THE REPORT OF THE EIGHTEENTH SESSION

- PART I. General Proceedings of the Session.
- PART II. Proceedings of Section A: Problems of Geochemistry.
- PART III. Proceedings of Section B: Metasomatic Processes in Metamorphism.
- PART IV. Proceedings of Section C: Rhythm in Sedimentation.
- PART V. Proceedings of Section D: The Geological Results of Applied Geophysics.
- PART VI. Proceedings of Section E: The Geology of Petroleum.
- PART VII. Symposium and Proceedings of Section F: The Geology, Paragenesis and Reserves of the Ores of Lead and Zinc.
- PART VIII. Proceedings of Section G: The Geology of Sea and Ocean Floors.
- PART IX. Proceedings of Section H: The Pliocene-Pleistocene Boundary.
- X. Proceedings of Section J: Faunal and Floral Facies and Zonal Correlation.
- XI. Proceedings of Section K: The Correlation of Continental Vertebrate-bearing Rocks.
- Proceedings of Section L: Earth Movements and Organic Evolution.
- Proceedings of Section M: Other Subjects.
- including meetings on the Geology and Mineralogy of Clays).
- of the Association des Services géologiques africains.
- the International Paleontological Union.